The reinvented museum

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The Reinvented Museum: Exploring Information Seeking Behaviour in a Digital Museum Context

Mette Skov

PhD thesis from Research Programme Information Interaction and Information Architecture
Royal School of Library and Information Science, Denmark

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Informationssøgeadfærd i en digital museumskontekst

Mette Skov

Ph.d.-afhandling fra Forskningsprogrammet Informationsinteraktion og Informationsarkitektur
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Abstract

The present thesis investigates characteristics of task-based information seeking behaviour in a digital museum context. Motivated by a gap in information seeking studies and a call for a supplementary end-user approach to virtual museum collections, the thesis suggests to draw on knowledge, methods and results from information seeking behaviour research to add to our understanding of why and how both museum curators and virtual museum visitors seek and use resource descriptions of museum objects. More precisely three factors are explored: information needs, information seeking and information use in a contextual framework. While task-based information seeking is the core interest of the study, the theoretical part of the thesis reflects how the thesis is situated in a unique and multidisciplinary intersection of three research areas: information seeking, interactive information retrieval, and the emerging field of museum informatics (e.g., Marty, Rayward, & Twidale, 2003).

The integrative cognitive view as outlined by Ingwersen and Järvelin (2005) serves as the main theoretical foundation of the thesis. In the integrative framework information seeking provides the context for interactive information retrieval. The influence from the integrated framework is reflected in the following three characteristics of the thesis: 1) involvement of genuine users with individual and potentially dynamic information needs; and 2) extension of information seeking towards task context; and 3) integration of information seeking and interactive information retrieval.

The present study was conducted as an exploratory case study based primarily on a qualitative research design. The case study was conducted at the National Museum of Military History, Copenhagen (Denmark) and included both museum professionals and virtual museum visitors.

In relation to the *museum professionals* a pre-study of informal knowledge gathering was followed by semi-structured in-depth interviews based on the critical incident technique (Flanagan, 1954) and work task complexity (Byström & Järvelin, 1995; Byström, 2002). Four main object-related work tasks were identified: collection management; answering of inquiries to the museum; exhibition planning and design; and research. The first two are mainly characterised by high a priori determinability and covers known item or data element needs, whereas the other two tasks are characterised by low to medium a priori determinability and cover a wider variety of needs including

muddled item and exploratory topical needs. Across the critical incident descriptions, two primary types of object-related information needs were identified among curators: 1) *Object of prior familiarity* concerning a need to verify and pursue an all-ready known museum object, and 2) o*verview and exploration* concerning a need to explore and gain overview of objects related to a certain topic, collection, or time period. In relation to task complexity the results verify earlier studies (Byström & Järvelin, 1995; Byström, 2002) and show that as task complexity increases, so 1) the complexity and variety of information needed increase (the needs for provenience information and associated, historical context information increases), 2) the number of types of information sources increases, and 3) the internality of sources decreases.

With respect to the *virtual museum visitors* a triangulation of research methods was applied. A web questionnaire survey gave initial, quantitative information about virtual museum visitors and recruited participants to a succeeding user study. The following user study applied simulated search task situations (Borlund, 2000b) and retrospective talk-aloud sessions in order to investigate searching behaviour. Follow-up qualitative interviews addressed real leisure tasks in a military history context. Based on the serious leisure perspective (Stebbins, 1994), user study participants were categorised as either *collectors* (the largest group) or *liberal art enthusiasts*. Results show that museum objects are *collectors'* primary interest, while the historical context is secondary. They mainly need factual, object-related information, photographs, and provenience information in their leisure tasks. *Liberal arts enthusiasts*, on the other hand, define their hobby as a broader historical interest, while the objects are secondary. Further, given a hypothesis on virtual museum visitors' exploratory information seeking behaviour, a high percentage of ill-defined information needs reflecting exploratory and semantically open search tasks was expected. However, the identified information needs were surprisingly well-defined known item needs. This said, the analysis also indicated results supporting an exploratory seeking behaviour. Finally, four characteristics of searching behaviour were identified: 1) highly visual experience, 2) exploratory behaviour, 3) broad know item/element search, and 4) meaning making.

In conclusion, the case study adds to our knowledge on characteristics of information seeking behaviour of museum professionals and virtual museum visitors. Thereby, it contributes to the improved support of electronic access to cultural heritage collections on the Internet.

Resumé

Denne afhandling undersøger karakteristika ved informationssøgeadfærd i en digital museums sammenhæng. Den bagvedliggende motivation er, at vi kun har begrænset viden om brugeres informationssøgeadfærd i relation til digitaliserede kulturarvs-samlinger. Denne afhandling tager derfor udgangspunkt i teori, metoder og resultater fra forskning indenfor informationssøgeadfærd for at bidrage til vores viden om, hvordan både museumsansatte og virtuelle museumsgæster søger efter og anvender information relateret til museumsgenstande. Tre faktorer undersøges i en kontekstuel sammenhæng: informationsbehov, informationssøgeadfærd og anvendelse af information. Afhandlingen bygger primært på informationssøgeadfærd i et opgave-orienteret perspektiv men inddrager ligeledes teori vedrørende interaktiv informationssøgning og teori fra det relativt nye fagområde *museum informatics*.

Teoretisk tager afhandlingen afsæt i Ingwersen og Järvelins integrerede kognitive forskningsperspektiv på informationssøgning. Dette kommer til udtryk gennem de følgende tre karakteristika ved det gennemførte studie: 1) inddragelse af brugere med individuelle og potentielt dynamiske informationsbehov, 2) inddragelse af elementer fra brugerens opgave-relaterede kontekst, og 3) kobling af teori og metoder om informationssøgning og informationsadfærd.

Empirisk bygger afhandlingen på et overvejende kvalitativt og eksplorativt casestudie. Casestudiet blev gennemført ved Statens Forsvarshistoriske Museum og omfattede såvel museumsansatte og virtuelle museumsgæster.

Den primære dataindsamlingsmetode i relation til museumsansatte var kvalitative interviews. På baggrund af de gennemførte interviews blev fire hovedtyper af genstandsrelaterede arbejdsopgaver identificeret: vedligeholdelse og udvikling af museumssamlinger, besvarelse af forespørgsler til museet, planlægning og forberedelse af udstillinger samt forskning. Undersøgelsen viste, at de første to typer af genstandsrelaterede arbejdsopgaver er kendetegnede ved en høj grad af a priori forudsigelighed og dækker veldefinerede, verifikative informationsbehov. Derimod kan de to andre typer af genstandsrelaterede arbejdsopgaver kendetegnes ved en lav eller middel grad af a priori forudsigelighed og disse arbejdsopgaver initierer flere forskellige typer af informationsbehov. Undersøgelsen bekræfter tidligere studiers påviste sammenhæng mellem arbejdsopgavers kompleksitet og en række aspekter af informationssøgeadfærd.

En metodisk triangulering blev anvendt ved studiet af virtuelle museumsgæster. Indledningsvist gav et online spørgeskema kvantitative oplysninger om de virtuelle

museumsgæster og spørgeskemaet blev ligeledes anvendt til at rekruttere deltagere til den efterfølgende brugerundersøgelse. Brugerundersøgelsen bestod af en kombination af en søgesession bestående af fire simulerede søgeopgaver med en efterfølgende tale-højt session med det formål at berige de indhentede data om søgeadfærd. Brugerundersøgelsen blev afsluttet med kvalitative interviews, som fokuserede på deltagernes hobby i relation til forsvars- og militærhistorie, og hvordan de i denne sammenhæng søger efter og anvender genstandsrelateret information. Analysen af de virtuelle museumsgæsters søgeadfærd viste en tydelig distinktion mellem to brugergrupper i form af henholdsvis samlere og såkaldte *liberal arts enthusiasts.* Den første brugergruppe lægger hovedvægten på information om selve museumsgenstanden i form af faktuel genstandsrelateret information, fotografier af genstande og oplysninger om proveniens. Den anden brugergruppes primære interesse er museumsgenstandens historiske kontekst, hvorimod selve museumsgenstanden er sekundær.

Generelt viste undersøgelsen at virtuelle museumsgæsters informationsbehov var overraskende veldefinerede og verifikative. Dog viser afhandlingen, at deres informationssøgeadfærd også rummer eksplorative elementer. Eksempelvis havde ikke mindre end 30% af spørgeskemarespondenterne ikke et egentligt formål med deres besøg på museets hjemmeside og de søgte ikke noget specifikt. Endelig identificerede studiet fire karakteristika ved virtuelle museumsgæsters søgeadfærd: 1) at det visuelle har en meget høj grad af betydning, 2) at søgeadfærden rummer tydelige elementer af eksplorativ og udforskende søgeadfærd, 3) at mange søgninger er brede verifikative søgninger efter på forhånd kendte genstande og typer af genstande, og 4) at de virtuelle museumsgæster i høj grad anvender deres egen baggrundsviden om området for at kontekstualisere og skabe mening, når de navigerer i digitaliserede kulturarvssamlinger.

I sin helhed bidrager afhandlingen ved at skabe ny viden om informationssøgeadfærd hos både museumsansatte og virtuelle museumsgæster i relation til digitaliserede kulturarvssamlinger.

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1 Introduction

1.1 Motivation

The past few decades have seen major changes and reorganisation of museums. The modern museum is information intensive, and the complexity of documentation accompanying museum artefacts is growing. Following the idea of the visitor-centred museum (G. Anderson, 2004) together with new possibilities of information technologies, there is a trend to make museum collections widely accessible by digitising cultural heritage collections for the Internet. At the same time virtual visits to museums have become popular and some museums report that the number of virtual visitors exceeds the number of visitors to the physical museum (Cunliffe, Kritou, & Tudhope, 2001; Haapalainen, 1999). In 1998 Hertzum describes the introduction of the Web in museum environments as a relatively new phenomenon. Since then museums have become well aware of the Internet's potential and today museum web sites cover a broad variety of genre and content size. Conference proceedings from a major conference, Museum and the Web, show the great variance of how museum professional make use of the Internet. From web sites essentially equivalent to electronic brochures, over virtual museums with online exhibitions, to web sites giving access to catalogue information of museum objects in collection databases.

Digitizing cultural heritage collections involves opening up databases, previously the sole domain of the museum professionals, to end users. However, opening up databases makes the collections available but not necessarily accessible (Trant, 2006). Several studies report on a mismatch between museum documentation and end-users' information needs (e.g., Booth, 1998; Chaudhry & Jiun, 2005; Stephenson, 1999; Trant, 2006). The mismatch can largely be explained by a specialist perspective and a collection management perspective on resource description, as museum documentation traditionally has been written for and by museum professionals and not end users. As a consequence of this mismatch the studies call for a supplementary (end) user oriented approach to virtual museums in general and to resource description of museum artefacts in particular.

Due to the recent changes in the museum domain and as a reply to the call for an end user oriented approach to virtual museum collections, this thesis suggest to draw on knowledge, methods and results from research in *information seeking behaviour*[1] to add to our understanding of how both museum curators and virtual museum visitors[2] seek and use resource descriptions of museum objects in collection databases. Information seeking studies within the museum domain are few and scattered. Krawchyna describes it the following way: “While studies of information seeking behaviour, information retrieval systems and metadata have a long tradition in library and information science, such research studies are at an early stage in the museum environment” (2004, p. 2). Motivated by this gap in information seeking studies and the call for a supplementary end user approach to virtual museum collections, this doctoral thesis explores the information seeking behaviour of both museum curators and virtual museum visitors. Focus is on information seeking behaviour in the context of online access to museum resources presented in collection databases, and not in relation to the physical museum. More precisely three factors are explored: information needs, information seeking and information use in a contextual framework.

The assumption behind the present work is that in order to create improved digital access to museum resources, it is important to improve our knowledge of the information seeking behaviour of both professional and non-professional users including the organisational, social and cultural context surrounding them. As a next step, knowledge of information seeking behaviour can help make better resource descriptions of museum objects, and thereby improve digital access to the national, cultural heritage. This assumption derives from the theoretical framework and the integrated approach to information seeking and retrieval as outlined by Ingwersen and Järvelin (2005) within the holistic cognitive viewpoint. This integrated approach provides, in relation to this thesis, a general framework to (1) handle the complexity of relations between cognitive actors taking part in a process of information seeking, and (2) relate the process of information seeking to information retrieval.

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[1] Wilson defines information seeking behaviour as “…the purposive seeking for information as a consequence of a need to satisfy some goal. In the course of seeking, the individual may interact with manual information systems (such as a newspaper or a library), or with computer-based systems (such as the World Wide Web)” (2000, p. 49).

[2] The term *virtual museum visitor* is used to denote all end-users outside the museum accessing digitised museum collections on the internet. The group of virtual museum visitors covers a broad variety of end-users; including lay people, amateur historians, and professionals.

1.2 Objectives of the thesis

The overall aim of the thesis is to extend our knowledge of information seeking behaviour of both museum curators and virtual museum visitors within the cultural museums. Implications of this knowledge can later be applied and contribute to improved electronic access to the national, cultural heritage. The present PhD project was established in cooperation between the Royal School of Library and Information Science, the Danish Ministry of Culture, and the National Museum of Military History (in short the Military Museum). The Military Museum formed the empirical setting of the case study. Chapter 5 provides full information on the methodical approach and the empirical setting.

The case study adds to the line of studies on users' information seeking behaviour within a specific domain. The study identifies and characterises work/leisure tasks and derived information needs in relation to textual descriptions of non-textual information objects. Focus is on how a user group seeks and uses a specific type of information resources: resource descriptions of museum artefacts. The objective of the thesis is to explore and gain insight into how this specific type of information is searched for and used in the information seeking process of museum curators and virtual museum visitors. In addition, inspired by the integrative cognitive view (Ingwersen & Järvelin, 2005), it is the aim of the thesis to extend the traditional information seeking study into an integrated point of view by exploring information seeking in a work/leisure context.

Following the integrating point of view a logical next step would be addressing implications for resource description, design of collection databases and the development of novel information access tools, based on the findings of this thesis. However, these steps are not part of the present thesis.

1.3 Research questions

Ingwersen and Järvelin's (2005) generalised model of interactive information seeking, retrieval and behavioural processes emphasizes how information seeking and retrieval processes are influenced by actor(s)' past and present socio-cultural or organisational context. The two main user groups in this study differ in relation to context. Virtual museum visitors are influenced by their leisure context, whereas museum curators are influenced by their organisational context. Based on Ingwersen and Järvelin's generalised model it is an underlying *hypothesis* that the information seeking behaviour of museum professionals and end users differ, which is important to acknowledge in order to qualify resource description of museum artefacts and to incorporate in information retrieval (IR) system design.

To uncover the determining factors of information (seeking) behaviour, Wilson (1981) recommends undertaking in-depth studies of well-defined groups of persons. Following Wilson's recommendations a case study, primarily based on qualitative methods, was conducted at the Military Museum. Given the two main user groups, the thesis concentrates on two areas within information seeking research: (1) research based on a work task framework in relation to museum curators, and (2) research in everyday life information seeking and more specifically the leisure/hobby context and derived leisure tasks in relation to virtual museum visitors.

While various aspects of information searching and information (seeking) behaviour of historians[3] (Case, 1991; Cole, 1998; Duff & Johnson, 2002; Talja & Maula, 2003; Toms & Duff, 2002) and museum professionals (Amin, Hardman, & Ossenbruggen, 2007; Zach, 2005) have been the subject of study in a handful of studies, no prior study has investigated the information seeking behaviour of museum professionals in a work task framework. One may ask *why* it is interesting to examine how museum curators seek and use catalogue information about museum artefacts, as museum documentation has always been an important topic for museum professionals (Marty et al., 2003). Virtual museum visitors constitute a relatively new user group. Why not focus solely on how virtual museum visitors seek information? The answer is threefold. Firstly, as mentioned in the motivation (section 1.1.) the past few decades have seen major changes and reorganisation of museums resulting in a changing identity of the museum domain. It is relevant to study how this changing identity has influenced museum curators work tasks and information seeking behaviour. Secondly, according to Ingwersen and Järvelin (2005) the six central components of the cognitive framework for information seeking and retrieval (the socio-cultural or organisational context, the information seeker, the interface, information objects, the IT system and their interaction process) are mutually influenced by one another and interact dynamically. Changes in the organisational and cultural context of the museum domain will influence curatorial work processes and museum documentation, and thus affect the information seeking situation and interaction of the virtual museum visitor. The six central elements should not be analysed in isolation but in an integrated perspective. Thirdly, in order to address the reported mismatch between museum documentation and

[3] Many museum curators at cultural museum are historians.

end users' needs (e.g., Booth, 1998; Chaudhry & Jiun, 2005; Stephenson, 1999; Trant, 2006) a characteristic of both user groups' information seeking behaviour is needed.

Several researchers have addressed the importance of *work tasks* as the driving force and motivational factor underlying information seeking and retrieval (e.g., Järvelin, 1986; Vakkari, 2003; Wilson, 1981). Further, studying work tasks can be viewed as an important element in integrating information need, information seeking and the information retrieval process. For example, Belkin (1990) state that ideally a study should connect the task with the search process in order to analyse how they interact. Also Vakkari stresses that "[i]t is obvious that our understanding of information searching is only partial, if we are not able to connect aspects of searching to the related task. The expected contribution of information to the task is reflected in relevance assessments of the information items found, and in the search tactics and use of the system in general" (2003, p. 413). The concept of work task is therefore used as a starting point to explore and characterise the information seeking behaviour of museum curators in an integrated perspective. The research questions to be answered regarding museum professionals are as follows:

1. What characterises information seeking behaviour of *museum curators*? As to:
   - 1.a Their object-related work tasks and derived information needs?;
   - 1.b What are the relationships between types of work tasks and types of information needed in those tasks?; and
   - 1.c What information sources are used in what kind of work tasks?

Studies of information seeking behaviour have mainly focused on job related environments and scientific users and students in particular (Butterworth & Perkins, 2006; Hartel, 2003; McKenzie, 2003; Savolainen, 1995). Savolainen put forward that non-job information seeking deserves equal attention and introduces the concept of everyday life information seeking (ELIS) defined as "…the acquisition of various informational (both cognitive and expressive) elements which employ to orient themselves in daily life or to solve problems not directly connected with the performance of occupational tasks" (1995, p. 267). In the present work, the information seeking behaviour of virtual museum visitors is explored within the framework of ELIS, and like e.g. Hartel's (2003) and Yakel's (2004) studies of ELIS focus is on the hobby area.

Inspired by findings in studies of museum visitor behaviour in physical museums (e.g., Black, 2005; Borysewicz, 1998; Semper, 1998; Treinen, 1993) it is a main hypothesis, that virtual museum visitors seek information in a highly exploratory manner, which is not necessarily task oriented with a predetermined information gap or need to be resolved (see also section 3.2.5). The hypothesis is also based on how Ross (1999) and Yakel (2004) in leisure contexts describe information seeking as non-goal oriented (see also section 4.2.2).

The following research questions are addressed with regard to virtual museum visitors:

2. What characterises information seeking behaviour of *virtual museum visitors*? As to:

- 2.a Their information related leisure tasks and derived information needs?;
- 2.b Which data elements are preferred in a searchable record of museum artefacts and why?;
- 2.c What information channels and sources are used in what kinds of leisure tasks?; and
- 2.d What characterises searching behaviour of virtual museum visitors, with focus on how different task types affect search attributes and search strategies?

The research design and applied methods for investigating the two user groups differ. This is reflected in differences between the research questions related to the two main user groups. In relation to the virtual museum visitors, simulated search task situations could be applied, thus providing an opportunity to analyse virtual museum visitors' searching behaviour (research question 2.d and partly research question 2.b). Chapter 5 on research methods provide detailed information on the different methodical approaches.

Answers to the above research questions result in a characteristic of the information needs and information seeking behaviour of museum curators and virtual museum visitors in relation to resource descriptions of museum artefacts. The characteristic aims to qualify resource description of museum artefacts and constitute a foundation for (a) development of knowledge organisation systems, and (b) integration of user requirements in IR system design. The study compares at a conceptual level how the two main user groups seek information.

1.4 Structure of the thesis

The thesis is divided into two main parts, a theoretical and an empirical part. The theoretical part consists of chapters 2, 3 and 4 and the empirical part consist of chapters 5, 6 and 7.

Chapter 2 provides an introduction to the cognitive viewpoint in Library and Information Science. Focus is on the *integrated view on information seeking and retrieval* as outlined by Ingwersen and Järvelin (2005) which is the main theoretical foundation of the thesis. The chapter outlines the development from the individual cognitive view to the integrated cognitive view. The chapter ends by discussing how the present thesis applies the integrated research framework.

Chapter 3 focuses on organisation and indexing in the museum domain and relates the thesis to the emerging field of museum informatics. The first part of the chapter addresses knowledge organisation and indexing in the museum domain and discusses the challenges and complexity of describing heterogeneous museum collections. The second part of chapter 2 focuses on perspectives on museum informatics and shows how museum informatics and new technology are becoming an integrated part of the reinvented museum.

Chapter 4 focuses on information seeking behaviour from a work task perspective and the chapter starts by discussing theoretical models of task-based information seeking. Given the two main user groups in the present case study, the succeeding part of chapter 4 addresses theoretical contributions and empirical studies related to two different contexts. First, information seeking in everyday life context, and more specific a hobby context, is approached in relation to virtual museum visitors. Next, the information seeking behaviour of historians and professionals within cultural heritage are addressed. As a whole the three theoretical chapters function as a theoretical framework and as an argumentation for the empirical work. Together the three chapters provide a unique connection between theories from information seeking and retrieval *and* the emerging field of museum informatics.

Chapter 5 is the methodical chapter. It starts by presenting the empirical setting and gives an introduction to the case, the Military Museum, and to the Military Museum's online catalogue used as a test system. Next, the chapter presents the research methods applied for both main user groups. In relation to the museum curators, in-depth qualitative interviews are the main method for data collection. In relation to the virtual museum visitors, a combination of a web questionnaire, user studies based on simulated search task situations and follow-up interviews are applied as methods for data collection.

Chapter 6 provides answers to the three research questions concerning museum curators. Likewise, chapter 7 reports on the results of the empirical investigation of virtual museum visitors and answers the last four research questions. Both chapters 6 and 7 also discuss the findings and relate them to previous studies.

The final chapter 8 concludes with regard to the seven research questions. Further, it presents the contributions derived from the thesis and recommendations for future research based on the results of the present study are presented.

2 Integration of information seeking and retrieval: a cognitive framework

This chapter introduces the cognitive viewpoint in information science with focus on the *integrated view on information seeking and retrieval* as outlined by Ingwersen and Järvelin (2005) which is the main theoretical foundation of the thesis. The integrated framework is based on a cognitive epistemological point of view and reflects an understanding of the information seeking and retrieval as a holistic *process* involving various cognitive actors in context.

One may divide the development of the cognitive approach to information science into two distinct periods. The first period covers mid 1970s to 1991 and was user- and intermediary-oriented. It can be characterised as the *individual cognitive view*. Since 1992 models and perspectives of information seeking and retrieval, relying on a cognitive view, have developed into a holistic or *integrated cognitive view* of all interactive communication processes (Ingwersen, 1999, p. 3). The first section discusses the individual cognitive view, with focus on its formation and main characteristics. The second section describes the changes leading to an integrated cognitive view (also named the holistic cognitive view). Further, the integrated view on information seeking and retrieval is presented and discussed as the latest contribution to and ripening of the viewpoint. The third section discusses criticism of the cognitive viewpoint. The section concludes why a cognitive foundation is chosen as the epistemological foundation of the thesis. The fourth section explains the thesis' foundation in the integrated framework within the cognitive viewpoint.

2.1 The individual cognitive view

Several research disciplines include elements of human cognition and cognitive processes involving communication and interaction. Influenced by a discussion of cognitive science in other research areas, the cognitive viewpoint was first introduced as an epistemological approach to information science in the mid 1970s (e.g., Belkin & Robertson, 1976; Brookes, 1975; 1977; De Mey, 1977; 1980) as one of many epistemological approaches[4]. Since then the cognitive approach has formed the basis of a substantial part of both theoretical and empirical work in information science and, according to Cole and Leide (2006, p. 174), the cognitive approach is now solidly developed as the primary paradigm in information needs and use research.

The cognitive viewpoint was introduced as an alternative to the mainstream system-driven IR tradition (Ingwersen, 1992, pp. 1-14), and attempts to bridge the gap between the system-driven tradition and the user-oriented tradition. The main focus of the *system-driven tradition* is the development and evaluation of effective representation techniques, storage and matching algorithms to be implemented in IR systems, placed in laboratory settings with little concern for real life situations in which users seek information. It adheres to the Laboratory Model for IR based on the Cranfield-model (Cleverdon & Keen, 1966; Cleverdon, Mills, & Keen, 1966), which builds on the principle of test collections including a document corpus, a set of well-defined requests (representing static information needs), and relevance judgements made by assessors. This setup supports experimental control of variables and comparability of results. The *user oriented tradition* studies IR in a broader perspective as a problem solving and goal-oriented, interactive process. This tradition considers knowledge of user's information behaviour, in contrast to IR matching techniques, to be a key solution for successful IR. Users' information seeking behaviour is often studied in empirical, real-life investigations and results include complex models of patterns in information behaviour.

The gap between the traditional system-driven approach and the user-oriented approach has been addressed several times (e.g., Ingwersen, 1996; Järvelin, 2007; Robertson & Hancock-Beaulieu, 1992; Saracevic, 1997). A determining difference between the two research approaches is the aim for experimental control and validity versus an aim for realism. In an article on IR system evaluation Robertson and Hancock-Beaulieu describe the conflict in the following way: "The conflict between laboratory and operational experiments is essentially a conflict between, on the one hand, control over experimental variables, observability, and repeatability, and on the other hand, realism" (1992, p. 460). This reflects a fundamental difference between the

[4] The most important epistemological or philosophical approaches in information science are, according to Ingwersen and Järvelin, pragmatism, rationalism, hermeneutics, and phenomenology, or information science research can be approached with a language-philosophical, semiotic, constructivist, sociological or cognitive point of view in mind (Ingwersen & Järvelin, 2005, p. 23).

research approaches, as the cognitive (and user oriented) approaches have a social science background, while the system-oriented tradition originates in computer science with focus on technological developments. Although both research areas are concerned with providing and improving access to information sources and investigation of retrieval effectiveness, the cognitive research landscape is broader. Järvelin pinpoints the limitations of the system-driven approach: "…that lab IR abstracts a mechanical component of human-literature communication and makes it the (isolated) object of inquiry. Removing individual subjectivity fosters homogeneous quantitative treatment of IR systems – but at the cost of not being able to handle problems by human behaviour and capabilities" (2007, pp. 973-974). The introduction of the cognitive viewpoint in information science can be viewed as *one* way to bridge the gap between the two approaches.

The breakthrough and formulation of the cognitive viewpoint in information science cannot be linked with one specific originator or event (De Mey, 1982). Instead, according to Belkin (1990, p. 11), a number of publications which explicitly call for, or propose, a cognitive view on information science started to appear in the mid-1970s[5]. The multidisciplinary Workshop on the Cognitive Viewpoint in Ghent (De Mey, 1977) is a critical event in the development process, and at the workshop De Mey coined the cognitive viewpoint for the first time: "The central point of the cognitive view is that any *processing of information*, whether perceptual or symbolic, is *mediated* by a system of categories or concepts, which for the information-processing device, are a *model* of his [its] world" (1977, p. xvi-xvii).

Later, other definitions of the cognitive viewpoint in an information science perspective have been proposed. For example, Wilson emphasises the central concept of *knowledge structures* when he proposed a more general definition of the cognitive view as: "…the idea of human perception, cognition, and structures of knowledge" (1984, p. 197). In an article on the meaning of the cognitive view of information science Belkin comments on the different definitions, and he concludes that "…no matter how general the definition, nor where its emphasis lies, the essence of the cognitive viewpoint is that it explicitly considers that the states of knowledge, beliefs and so on of human beings

[5] A cognitive approach is not particular to information science, as a so-called cognitive revolution occurred in several research disciplines (for example psychology, linguistics, neuroscience, and computer science) concurrently (De Mey, 1977; Miller, 2003).

(or information-processing systems) mediate (or interact) with that which they receive/perceive or produce" (1990, pp. 11-12).

Further, the above mentioned multidisciplinary workshop is critical in the development of the cognitive viewpoint in information science because it includes contributions from B.C. Brookes, N.J. Belkin, M. De Mey, and P. Ingwersen (Belkin, 1977; Brookes, 1977; De Mey, 1977; Harbo, Ingwersen, & Timmermann, 1977). These four scholars play a leading role in the formulation and shaping of the cognitive view (Borlund, 2000a). They are mentioned in this context as their contributions have had strong influence on the shaping of information seeking and retrieval research. This includes impact on the integrated cognitive approach to information seeking and retrieval applied in this thesis. Aspects of the four scholars' contributions will be discussed and linked with later work in this and the following subsection.

In the first period, cognitive IR research is strongly influenced by De Mey's epistemological work and especially his formulation of the central point cited above. De Mey illustrates the implications of his understanding of the cognitive view by proposing four evolutionary stages through which thinking on information processing has developed: a monadic stage, a structural stage, a contextual stage and finally a cognitive or epistemic stage (De Mey, 1980, p. 49). The processing becomes more and more complex through the four stages. The first three stages correspond to levels of language understanding equivalent to the linguistic surface levels of data processing. The fourth stage corresponds to the pragmatic level of perceiving and interpreting information and thus includes a subjective understanding which only humans are capable of (Ingwersen & Järvelin, 2005, p. 26). De Mey's fourth stage illustrates the level on which human information processing takes place (Ingwersen, 1992, p. 23) including processes of the information need formation and development. The cognitive or epistemic stage can thus be viewed as an alternative to the traditional system-driven approach to IR (see above) represented in the three first stages.

Already during the period of the individual cognitive view, researchers started to acknowledge the *complexity* of cognitive structures involved in an interactive IR process, later leading to an integrated cognitive view. For example, Brookes' fundamental equation model of how knowledge structures are affected and change as a result of externally added information can be viewed as a model of how both the information system and the user can act as recipient. According to Brookes (1977) cognitive processes occur at both ends of the communication 'channel'. In other words processing of information takes place in both senders and recipients of information, and information systems may, similarly to human actors, act as a recipient applying its own world model. Also Ingwersen's extension of De Mey's definition of the cognitive view emphasises the complexity of cognitive structures involved in interactive IR. Ingwersen adds that the world model consists of cognitive structures determined by "…the individual *and* its social/collective experiences, education, training etc. (Ingwersen, 1982, p. 168). The extension emphasises how cognitive structures of the individual are influenced by social, cultural, or organisational contexts leading to a variety of individual differences in knowledge structures. Thus the task of IR is thus to *bring into accord* the cognitive structures of different actors (Ingwersen, 1982, p. 169).

Wilson (1984) also takes a cognitive view and like Ingwersen, he suggests to analyse the individual actor's model of the world within a contextual framework. Wilson focuses explicitly on information seeking behaviour and information use, and he points out that interactions between the individual actor's model of the world and what influence them are aimed at understanding or generating meaning from that which is perceived, and further that significant aspects of these models refer to the context in which the person is situated.

Despite this acknowledgment of the complexity of cognitive structures involved in an interactive IR process and a beginning interest in studying the context of interaction, it was not reflected in empirical research based on the cognitive viewpoint until the 1990s. The majority of empirical studies in the first period concentrated mainly on the nature of individual cognitive structures of users, their interaction with IR-systems or the formation of information needs (Ingwersen, 1999). As a reaction against the dominating system-driven IR tradition the aim was to improve our understanding of the characteristics of the interactive IR processes and factors affecting the individual structures of participating actors. Two early studies, central to understanding interactive IR and influential in the theoretical development during the initial period, are mentioned in the following.

Based on reference situations in libraries, Taylor (1968) developed a model of how an information need or problem may develop in the mind of a user: from a psychological state of mind to an expressed need. In the four stage model, the first two stages, Q1–Q2 (named the visceral and the conscious), are internal to the user representing a psychological state of mind. Whereas in the last two stages, Q3-Q4 (named the formalized and compromised need respectively), the information need is expressed either to an intermediary person or an information system. Taylor suggests that the information need or problem proposed to the information system is a compromised need not fully reflecting the underlying information need[6]. Taylor's stages 1-2 became later criticised for being too simplistic and speculative and reflecting a static need conception (Hjørland, 1997; Ingwersen, 1992) and much more attention was directed towards Taylor's five filters. The intermediary needs to pass through five filters with reference to the inquirer (subject definition, objective and motivation, personal characteristics of inquirer, relationship of enquiry to file organisation, and anticipated or acceptable answers) in order to uncover the user's underlying need and match it with relevant information. Parallel to other studies in the initial period, Taylor analyses cognitive processes involved in need formulation *independent* from problem situation or task and how the need arises. However, two of the filters (about objective and motivation and anticipated or acceptable answers) concern the *intentional cause* (work task, interest, problem or goal) underlying the information need, and thus relates to contextual factors later gaining considerably attention in the integrated cognitive view. Even though Taylor did not refer to cognitive theories, his work is an important contribution and influential factor on e.g. Belkin's formulation of the concept of anomalous state of knowledge (ASK).

Based on empirical investigations of information seeker's 'problematic situation' as a trigger to information seeking, Belkin (Belkin, 1980; and with Oddy & Brooks, 1982) introduces the ASK hypothesis, which concerns the development of the individual information need. The ASK hypothesis is that "…an information need arises from a recognised anomaly in the user's state of knowledge… and that, in general, the user is unable to specify precisely what is needed to resolve that anomaly" (Belkin et al., 1982, p. 62), thus it may be more suitable for the user to describe the anomaly (or information gap) than to specify the information need. Two central findings, in relation to the ASK hypothesis, are important. Firstly, the studies point to the 'problematic situation' including real life problem statements and the pre-information searching behaviour stages as a mean to provide knowledge concerning formation and development of the information need. Secondly, the user's information need can be seen as a reflection of an anomalous state of knowledge, changing the concept of information need from a static to a potentially dynamic concept.

Belkin's formulation of the ASK hypothesis can be viewed as the cognitive breakthrough in information science and in addition to providing central knowledge on

[66] Ingwersen (1984) discusses Taylor's work and he empirically verifies the compromised need and demonstrates how it leads to the Label Effect: searchers rarely express all what they actually know about their information gap.

the individual information need, situated in a problematic situation and on system design, two basic types of ASKs were identified: a well defined and a more-or-less ill defined one (Belkin, Seeger, & Wersig, 1982). These two basic types of information needs of dynamic nature correspond well with Ingwersen's (Ingwersen, 1982) protocol analysis findings, identifying the verificative and the conscious topical needs as well as an ill-defined type, which later are refined into eight types of information needs defined by three dimensions (Ingwersen & Järvelin, 2005, pp. 289-293). Together the two studies by Taylor and the Belkin group lead to the understanding of the central role played by the *interaction process* (to obtain information on the intentions and context of users) and *reasons* for the formation of the information need (problematic situation, recognition of knowledge gap and state of uncertainty).

This section has discussed the formation and central aspects in the development of the individualistic cognitive view. In the beginning of the 1990s new research challenged both the system-driven IR tradition and research in cognitive IR leading to a cognitive turn. The turn from an individualistic cognitive view to a holistic cognitive view "…implies a shift *from* believing in the possibility of bringing the variety of cognitive and functionally different structures in IR in harmony, *to* the acceptance that such structures are inherently different, and should be exploited as such" (Ingwersen & Järvelin, 2005, p. 30). The following section discusses the integrated cognitive view and the determining elements leading to the cognitive turn.

2.2 The integrated cognitive view

Since the beginning of the 1990s, theoretical understanding and models of information seeking and retrieval (IS&R), building on a cognitive viewpoint, has developed into an integrated framework. The development (or shift) took place due to several circumstances[7] and the following two theoretical contributions had decisive influence.

Firstly, Schamber, Eisenberg and Nilan's (1990) proposal of situational relevance, viewing relevance as a complex, multidimensional and dynamic concept, started a renewed discussion of relevance challenging the view on relevance and interaction taken in mainstream IR experiments (as e.g. TREC). The concept of situational relevance refers to the usefulness of an information object in relation to the work task at

[7] For detailed information on the circumstances leading to the shift see Ingwersen (1999, pp. 11-13).

hand underlying the information need as perceived by the user (Borlund, 2003), and as a consequence situational relevance is highly context dependent. Consequently, the introduction of situational relevance has put emphasis on task-based IR and seeking and on contextual features of such processes.

Secondly, based on an analysis of the increasing complexity of the IR research situation, Robertson and Hancock-Beaulieu (1992) point to three recent revolutions: the relevance, the cognitive and the interactive revolution. In their opinion, understanding the three revolutions is critical in order to proceed towards a more holistic approach to IR. The relevance revolution (building on R. S. Taylor, 1968) concerns the acceptance that a stated request is not the same as information needs, and consequently relevance should be judged in relation to needs rather than requests. As a result of the cognitive revolution an information need is viewed as a reflection of an ASK (Belkin, 1980; Belkin et al., 1982) and consequently an information need is understood as a dynamic and individual concept. The interactive revolution points to the fact that IR systems have become increasingly complex and interactive, and that interaction, e.g. in the form of relevance feedback, is central to the understanding of IR.

The introduction of the concept of situational relevance and the formulation of the three revolutions challenge the (experimental) IR research field along with the individual cognitive approach. As a result IR experiments and evaluations have to look at the *process* of interaction and the *context* surrounding the IR situation (e.g. perceived work tasks and the information seeking process) in order to incorporate realism and handle the concept of situational relevance. Accordingly, the emerging holistic approach to information seeking and IR implies an integrative and continuous process of interpretation and cognition taking place on both the user-side and on the system side during interaction.

Concurrently information seeking is increasingly seen as contextual to interactive IR (Belkin, 1993; Ingwersen, 1996; Järvelin & Ingwersen, 2004; Saracevic, 1997; Wilson, 1999), see Figure 2.1. Information seeking and IR are both aspects of information behaviour activities. *Information behaviour* is a broad concept and covers the "…activities a person may engage in when identifying his or her own needs for information, searching for such information in any way, and using or transferring that information (Wilson, 1999, p. 249). *Information seeking* is a subset of information behaviour and can be seen as a person's purposive seeking for information in order to satisfy an underlying goal (Wilson, 2000, p. 49). *IR* has an even more narrow focus and concerns formal algorithmic processes of representation, storage, searching, finding, filtering, and presentation of potential information perceived relevant to a requirement

(Ingwersen & Järvelin, 2005, p. 21). *Interactive IR* is information acquisition via formal channels and in organised knowledge such as information system, whereas information seeking also includes acquisition through informal channels such as colleagues. Wilson's (1999) original nested model demonstrates the interrelatedness between three of the central concepts by stressing that interactive IR[8] occurs in the context of information seeking and further in the broader context of information behaviour activity.

Figure 2.1 also depicts Ingwersen and Järvelin's modification of Wilson's nested model which is further extended by the present author. In the modified version the underlying situational reasons for information behaviour are added by demonstrating how a work task or interest (whether job or non-job related) is the driving force behind any information seeking activity. The concept of *work task* becomes increasingly central as the *contextual* dimension of information seeking and IR gains more momentum in the research (Bystrom & Hansen, 2005; Järvelin, 1986; Marchionini, 1995; Park, 1993; Vakkari, 2001b; 2003). The concept of work task is discussed in chapter four. The further extension of the model from Ingwersen and Järvelin (2005) modifying Wilson's original model (1999), Figure 2.1, implies to view formal (algorithmic) IR in context of interactive IR. Interactive IR becomes thus the central bridge that connects formal laboratory-based IR with information seeking processes, emphasising their *integrative* nature.

[8] Wilson (1999) uses the term 'information search behaviour' instead of interactive IR. Thereby Wilson stresses that searching concerns interactions between information user and computer-based information systems, of which information retrieval systems for textual data may be seen as one type (1999, p. 263). The term "searching" might also be preferred as interactive IR can be seen to typically concentrate on a single search session (Vakkari, 1999, p. 821). This thesis uses the terminology suggested by Ingwersen & Järvelin (2005) as it underlies the integrative framework adopted.

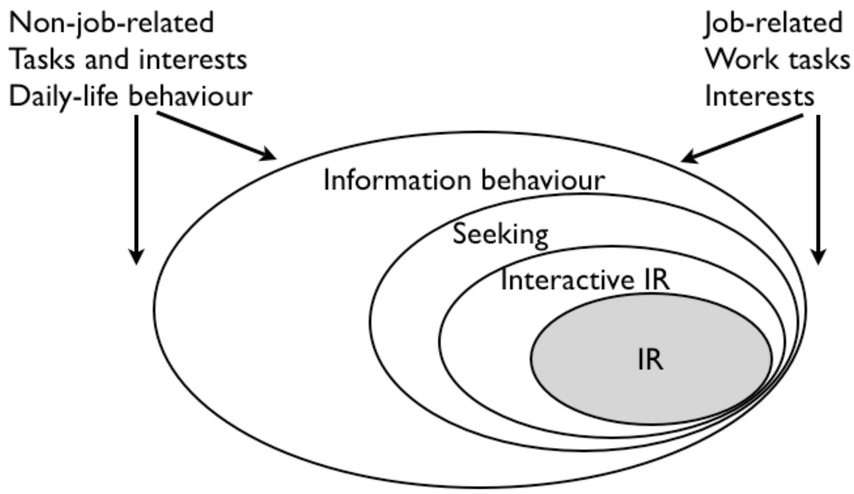

Figure 2.1: Nested model of information behaviour. Extension of Ingwersen and Järvelin (2005, p. 198) and Wilson (1999, p. 263).

This and the previous section show the development from an individualistic to an integrative cognitive research approach. Within the cognitive framework there are several research models in play and no consensus comparable to laboratory IR regarding the approach (Ingwersen & Järvelin, 2007, p. 973). In this thesis Ingwersen and Järvelin's (2005) integrated framework to information seeking and retrieval is chosen as the research framework. The comprehensive framework can be seen as the latest ripening of the viewpoint. The integrated framework and how it is applied to this thesis is discussed next.

2.3 The integrative framework for information seeking and retrieval

The aim of the proposed framework is to integrate information seeking and information retrieval into IS&R by extending the two research areas in question (library and information science and computer science respectively) to capture more of each other and of context (Ingwersen & Järvelin, 2005, p. 2). Further, they provide perspectives from/to context by presenting a research framework that incorporates contextual components, situational factors as well as the traditional search engine and document based approaches. A framework which, in relation to this thesis, demonstrates how to extend information seeking perspectives towards both tasks and technology.

In their monograph Ingwersen and Järvelin (2005, pp. 25-28) identify five central and interrelated dimensions of the cognitive view. The five dimensions are presented as central and representative of the cognitive view in general, however, at the same time they reflect the development illustrated above. A development from an individualistic to a holistic view and consequently the cognitive view anno 2005:

1. *Information processing takes place in senders and recipients of messages*.
   Building on Brookes (see section 2.1) the actor – either human or machine – acts as both sender and receiver of information. Further, the first dimension stresses how the view is not limited to user-centered approaches. It is human-oriented and encompasses *all* information processing devices.

2. *Processing takes place at different levels*.
   Levels of processing relates to the notion that information processing takes place at different levels depending on whether the actor is a human or a machine, and how and when to talk about information vs. data processing, signals or signs. With reference to De Mey's four evolutionary stages of processing (see section 2.1), Ingwersen and Järvelin (2005, p. 26) point to how information, on a cognitive/epistemic level, becomes a construct deriving from the actor's own world model in context and/or a perceived message in context. The less the context is available to the actor, the more freedom for interpretation. This 'semantic openness' entails uncertainty which stresses the importance of including contextual factors in information processing.

3. *During communication of information any actor is influenced by its past and present experiences (time) and its social, organizational and cultural environment*.
   According to this view, the individual actor is influenced (but not determined) by his experience and environmental context. The actor's 'cognitive model' consists of cognitive structures, defined to include emotional state, that are based on individually interpreted situations and perceived social/collective experiences, education, etc. (Ingwersen, 1982, p. 168). 'Actor' represent any actor taking part in IS&R processes.

4. *Individual actors influence the environment or domain*.

Collective cognitive structures may be generated and modified over time as a result of *social interaction* between individual actors entailing shared understanding of concepts, perceptions of work tasks, situations, and relevance.

The third and the fourth central dimensions show that the dynamic connections between the individual actor and the social or organisational domains (including knowledge and behaviour, culture, goals, preferences, and experiences) are mutual. In combination the third and the fourth central dimension are the essential elements of the so-called *principle of complementary social and cognitive influence* (section 2.3.2). The introduction of this principle reflects the recent growing emphasis on including context or environment in IS&R studies.

5. *Information is situational and contextual*.
   Due to the contextual nature of information, the time dimension, and influence of social interaction between individual actors, information as well as IS&R become situational[9].

The five central dimensions above show the holistic cognitive foundation of the integrated framework.

The cognitive framework centres on including the variety of cognitive actors involved in the information seeking and retrieval process. Ingwersen and Järvelin present a generalised and conceptual model of the interactive IS&R processes to demonstrate the complexity of the framework's cognitive structures associated with the five components: 1) Organizational, social, cultural context; 2) information seeker; 3) interface; 4) IT setting; 5) information objects. The *interactive processes* in the model can be viewed as an additional *sixth* component. The generalized model is depicted in the lower half of Figure 2.2. Further, a detailed version of the model is discussed in relation to the case study in section 2.4.2 and is depicted in Figure 2.3.

The integrated framework, including the generalized model, is an explicit continuation of Ingwersen's earlier work. The model has been elaborated several times adding the level of complexity, for example to include longitudinal interaction and also

[9] According to Ingwersen and Järvelin (2005, p. 42) focus on the situational context adheres to Luria's (1976) investigations of human classification of objects dating back to the 1920s.

to include the changing role of the information seeker into generator over time. Thus, even though the model emphasises the information process involved in IS&R, it also encompasses processes of information behaviour such as use, creation and communication, in line with Wilson (1999). The model's five components can be studied in isolation, but due to interaction and interrelatedness between the components, an integrative approach considers such investigations to be rather fruitless. The fact that IR processes are always embedded in broader information seeking activities argues for an integrated approach which the generalized model (depicted in the lower half of Figure 2.2) illustrates:

> "By integrating information seeking and interactive IR the model points to how evidence of a searcher's information behaviour may be applied to guide or adjust algorithmic information processing in system components through IR *interaction*. […] Further, the better we understand such evidence deriving from the context located *outside* IR systems proper, the better support can be provided to the algorithms in order to better serve the searcher…" (Ingwersen & Järvelin, 2005, p. 275).

The two-level principle of the cognitive communication system is illustrated in Figure 2.2. The lower social and physical level illustrates how the five components and their interactive phenomena are observable in the physical world. Viewed from an information seeker's perspective, the upper cognitive-emotional level denotes his cognitive model including his perception or interpretation of the situation including his perception of the five elements. Different sets of investigation methods must be applied to study the two levels respectively.

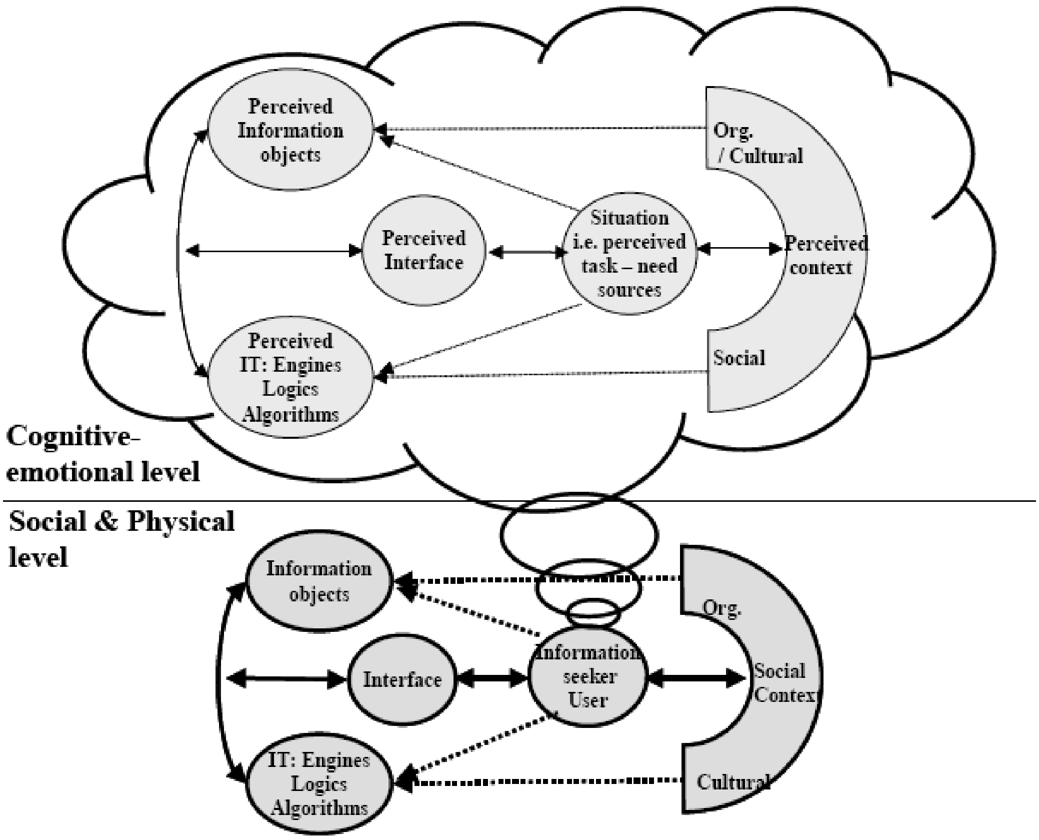

Figure 2.2: The integrative cognitive framework for information seeking and IR seen from a social and physical level, and as perceived from the information seekers cognitive-emotional level (Ingwersen & Järvelin, 2005, p. 278).

Ingwersen and Järvelin's integrated framework demonstrates a contextual orientation towards IS&R. The concept of context is widely used within information science, however, according to Dervin (1997, p. 14) there is no term more often used, less often defined and, when defined, defined so variously as context. For that reason the concept of context is shortly discussed in the following sub section in order to explain how 'context' is used in this thesis. Afterwards, section 2.3.2 discusses the role of context in individual cognition.

2.3.1 The concept of context – approaching the 'unruly beast'

As researchers have moved away from a de-contextualised and system-centered view, context has become a hot topic both in information science as well as in other scientific disciplines (Dervin, 1997). It is generally agreed that information seeking and IR are inherently interactive processes, which occur within multiple, overlapping contexts that inform, direct or shape the nature of interaction (Cool & Spink, 2002, p. 605). In other words how people access information is highly dependent on the context of their interaction and this context is influenced by a range of factors.

In spite of the growing attention to context in information science no uniform definition exists of what the concept entails and which elements are important to information behaviour. In Dervin's (1997) analysis of various contextual approaches, she labels context as an 'unruly beast' because of the difficulties in characterising and defining the concept and gaining methodological control over it. As a result the concept is used and defined variously. Part of the confusion is of paradigmatic nature.

Depending on the paradigmatic approach, context is conceptualised and analysed differently. The divide can be seen as a continuum. At one end, the objectified or positivistic approach sees context as yet another analytical factor that should be taken into account along with other factors (Dervin, 1997; Talja, Keso, & Pietiläinen, 1999). In this logic, context has the potential of being virtually anything that is not defined as the phenomenon of interest. The goal is to identify which aspects impact or relate to the phenomenon at hand and then adapt information systems based on these inputs. At the other end of the continuum, the interpretative or social-cultural approach does not understand context as an independent variable. Instead it sees context as a carrier of meaning without which any possible understanding of human behaviour becomes impossible (Dervin, 1997; Talja et al., 1999). In addition, every context is by definition different and thus generalisation in the traditional sense is impossible (Dervin, 1997). In the latter view context is too complex and we cannot know which contexts are important. It is important to note that along this context continuum a variety of approaches exists.

In practice, context in LIS[10] studies usually refers to any factors or variables that are seen to affect individuals' information seeking behaviour such as work roles, tasks,

[10] In their article Talja, Keso and Pietiläinen (1999) use the term 'information needs and seeking research" instead of library and information science research.

problem situations, communities and organisations with their structures and cultures (Talja et al., 1999). Contexts are multi-dimensional in that they can be described by a variety of attributes (Dervin, 1997). Examples of attributes that have been used to describe contexts include time, place, types of participants, history of interaction, the tasks motivating the interaction and the technical possibilities of the information systems. In addition context can be viewed as the socially defined settings, within which different *situations* take place (Allen, 1997). For example, within the organisational context of a cultural museum, planning an exhibition and attending a meeting are two different situations within the same context. Individuals may describe a given situation somewhat differently due to background knowledge, previous experience etc.

The discussion above shows how contexts within which a person seeks information are influenced by various factors. At another level of analysis, understanding context within the IR interaction itself is important (Cool & Spink, 2002). Accordingly, they describe four salient levels which to a large extent correspond to Wilson's information behaviour model: 1) the information environment level within which information behaviours take place. At this level concrete examples might be institutional, organisational or work task settings; 2) the information seeking level focuses on the goals a person is trying to achieve or a problem resolution task that influences the IR interaction level. At the second level, information use, resolution of ASK or stages in a search process may be addressed; 3) the IR interaction level of context explores the user-system interaction within search sessions; and 4) the query level explores the linguistic level of context in association with system performance.

A similar multi level approach to understanding context is illustrated in Ingwersen and Järvelin's (2005, p. 281) integrated framework. They add two additional levels of context: 1) by stressing the role of the historic context which drives and shapes the current situation (Ingwersen & Järvelin, 2005, p. 278) and, 2) relationships between single information objects, like citations or references. In line with the integrated framework, this thesis does not apply an interpretative or social constructionist approach. Instead an 'in-between' approach is chosen, meaning that context's influence on the cognitive actor is acknowledged, however, not in a determining way (see next section). At the same time, the work task (or daily-life task or interest) situation is seen as the central element of the context, placing our focus on contextual factors at the information seeking and to a degree the interactive IR levels.

Approaching context is seen as a way to add value or ‘digging deeper’, as Dervin (1997) suggests, when exploring information seeking behaviour, and it help us to understand complex relationships among contextual factors and human information behaviour.

2.3.2 The principle of complementary social and cognitive influence

The central cognitive actor in the integrated framework is the information seeker. After discussing the role of context, the following interesting question prompts: “…whether the context or environment is *the* determining factor for individual cognition or whether it is the individual perception of that context situated in interaction that determines the outcome” (Ingwersen & Järvelin, 2005, p. 30). The question relates back to the third and fourth central dimensions of the cognitive view (section 2.3). According to the perspective of the integrated model, focus is on the individual but no longer isolated from its context. Instead, each actor in an interactive IS&R process interacts with other actors and are *influenced* (but not *determined)* by context and work task (or interest) situations over time (2005, p. 31).

The influence between the individual actor and the social situation and context is mutual or bi-directional, meaning that the environment is also influenced by the individual actor, which stresses the individual’s *active* role in contextualisation (Johnson, 2003). Due to the individual actor’s relative autonomy (influenced by environment), the actor may contribute to environmental change, e.g. of a scientific domain or of a professional work setting. This dynamic of influence is called the *principle of complementary social and cognitive influence* (Ingwersen & Järvelin, 2005, p. 31). The introduction of the principle reflects how the social behaviour of the information seeker has gained more emphasis and it is a contrast to the early individualistic cognitive view.

Some critics of the cognitive view have argued against the former individual approach and may argue against the *principle of complementary social and cognitive influence*, claiming that individual users’ knowledge structures and information behaviour indeed are determined by participation in socially grounded domains. Although many researchers have applied the cognitive framework and contributed to the development of it within information science, its perspective has also been the subject of criticism.

2.4 Criticism of the cognitive view

The most commonly stated criticism against the cognitive viewpoint is related to A) the applicability of the viewpoint to information science research; and B) the claimed narrow user-recipient centred focus. This section summarises and comments the criticism.

Firstly, criticism as to the applicability of the viewpoint in terms of empirical based research is put forward by e.g. Ellis (1992) and Vickery (1997). According to Ellis no scientific achievements can be identified serving as exemplar for the cognitive approach. This criticism is proven wrong by early empirical work by, e.g., Belkin, Seeger and Wersig's (1982) on a framework for intelligent interface design, Saracevic and Kantor's (Saracevic & Kantor, 1988a; Saracevic & Kantor, 1988b; Saracevic, Kantor, Chamis, & Trivison, 1988) combined study of information seeking and retrieval, or the protocol analysis by Belkin (1984) and Ingwersen (1982) as well as Pejtersen's (1989) Book House fiction retrieval system. Later empirical work based on the integrative cognitive view includes, for example, Borlund (2000b) who suggests how to evaluate interactive IR systems by the use of simulated work task situations; Vakkari's (Vakkari, 2000b; Vakkari & Hakala, 2000; 2001a) extension of the Kuhlthau model based on a series of longitudinal empirical studies, and recent empirical investigations of the principle of polyrepresentation, which explicitly takes advantages of the diversity in cognitive representations (Kelly, Dollu, & Fu, 2005; Larsen, 2004; Skov, Larsen, & Ingwersen, 2006; 2008; R. W. White, Jose, & Ruthven, 2006).

Secondly, the cognitive approach has been criticised for being individualistic with a user or recipient-centred focus neglecting the social dimensions of the discipline (Frohmann, 1992; Hjørland & Albrechtsen, 1995; Hjørland, 1997; Talja, 1997). The critics argue that individual users' knowledge structures and information behaviour are shaped through participation in socially grounded domains. They claim that a fundamental weakness of the cognitive view is that it is based on individual mental processes. Accordingly, Hjørland and Albrechtsen (1995) do no recognise analysis of users' information needs and search strategies as starting point for system design and analysis of information behaviour, as it is often defective. Instead they recommend examining the information structures of a scientific knowledge domain, including the size of its literature, citation patterns, knowledge organisation, the distribution of the literature on various publication forms, interdisciplinary exchange etc. The critics stress the danger of studying individual's behaviour or thinking as basis of system design. This is an important point, however, the criticism seems unnecessary and faded as the individualistic cognitive viewpoint in the meantime has evolved and turned into an integrated view, encompassing all the interactive communication processes, and accentuating the importance of the situational and temporal contexts which surround the user (see section 2.1 and 2.2).

Given the thesis' overall aim, to contribute to improved electronic access to the national, cultural heritage by extending our knowledge of information seeking behaviour of both museum curators and virtual museum visitors within the cultural museums, and the chosen research questions, the integrated cognitive view is chosen as the epistemological foundation of the thesis. It is selected because it demonstrates explicit models for information science *and* points to solutions not solvable otherwise (Ingwersen & Järvelin, 2005, p. 23). The integrated research framework provides perspectives on how to extend studies of information seeking towards task context and information system design.

2.5 The integrated research framework as foundation of the thesis

The present thesis applies the integrated research framework from a seeking perspective. The objective of the thesis, as mentioned in chapter 1, is to explore and gain insight into the information seeking processes of museum curators and virtual museum visitors in the context of virtual museums. The influence from the integrated framework can particularly be traced in the following characteristics of the thesis:

1. The involvement of genuine users with individual and potentially dynamic information needs;
2. The extension of information seeking towards task context
3. The integration of information seeking and interactive IR

Firstly, the involvement of genuine users is a critical element in the cognitive viewpoint, and a main characteristic that differentiates the cognitive viewpoint from the system-driven approach. Although, according to the integrated research framework, it is indeed possible to make use of user simulations as well as simulated work tasks in laboratory-like experimental settings (Ingwersen & Järvelin, 2005; 2007). The thesis is based on empirical data from a case study at the Danish Military Museum including investigations of genuine information seekers in terms of both professional museum curators and virtual museum visitors. The involvement of genuine users allows us to study users' actual information needs. Information needs originates from the user's perception of the work task (either job or leisure related) situation at hand, and therefore an information need is related to the individual user. An information need is potentially dynamic, since 1) interaction with the information retrieval system may result in a change in the user's cognitive structures (Borlund & Ingwersen, 1997, p. 20) *and* as 2) the user may change his perception of the underlying work task and the information needed.

Secondly, the extension of information seeking towards task context can be seen as a logic consequence derived from the conception that the work task serves as the driving force underlying IS&R. In this study the work task situation is seen as the central element of context (see section 2.3.1), placing our focus on contextual factors at the information seeking level. Thus, characteristics of two different work task situations are relevant in relation to our case study: the organisational context of the professional museum curator; and the leisure context of the virtual museum visitor.

Thirdly, as shown in section 2.3 the main motivation behind the integrated framework is to extend the research area of information seeking and IR research towards each other. In the thesis the focus is on the information seeker's perception of the situation at hand and the information objects, at a cognitive-emotional level of Figure 2.2. The knowledge learned about the information seeker and relevant contextual factors can as a next step be used to address implications for the handling of the information object component and the IT system, at the social-physical level of Figure 2.2.

The following three sub sections explain, based on Ingwersen and Järvelin's main model of the complexity in the cognitive framework, (1) how this research project can be situated in the intersection of four research areas (information seeking, interactive information retrieval, knowledge organisation, and museum informatics) within information science, (2) how the model's six main components can be characterised in relation to this study, and (3) which of the components are dependent and independent variables.

2.5.1 Study of information seeking in a multidisciplinary intersection

Ingwersen and Järvelin's (2005, p. 261) generalised context model of participating cognitive actors in interactive information seeking, retrieval and behavioural processes (Figure 2.3) is normally used to provide an overview of the complexity in IR interactions. Likewise, at a meta level the generalised context model can illustrate the different research areas included in a study. The current research project is situated within an intersection of four research areas: information seeking, interactive IR, knowledge organisation and museum informatics.

As stated above the core interest of this study is information seeking behaviour, which is subsumed in the 'cognitive actor' component in the integrated research framework, potentially communication with other humans (social interaction) or/and IR systems (IR interaction), Figure 2.3. Further, information seeking is analysed within the integrated research framework extending information seeking towards task context. This is illustrated by the right-hand circle in Figure 2.3.

Even though the main emphasis is placed on information seeking behaviour, the thesis also relates to two other research areas. Firstly, the study includes elements of *knowledge organisation*, characterised as the description of documents, their contents, features and purposes, and the organization of these descriptions and as such contribution to information system design. The knowledge learned about the information seeker component can be related to elements of knowledge organisation subsumed in the information object component, illustrated by the left-hand circle in Figure 2.3. Accordingly, empirical evidence of the information seeking behaviour of virtual museum visitors and museum curators can as a next step be applied to qualify resource description of museum objects and the construction of searchable records. Characteristics of knowledge organization within cultural museums are discussed in section 3.1.

In addition, this study aims at contributing to the research area of museum informatics. Museum informatics is a sub-discipline to museum studies and can be defined as the study of how information science and technology affect the museum environment (Marty et al., 2003). Museum informatics builds on different disciplines and can be undertaken from multiple perspectives, including those of museum professionals and museum visitors (Marty et al., 2003, p. 260). Within this broad definition, museum informatics is not restricted to a single component in the generalised integrated framework but can be reflected in *all* the components. The new field of museum informatics is further discussed in section 3.2.

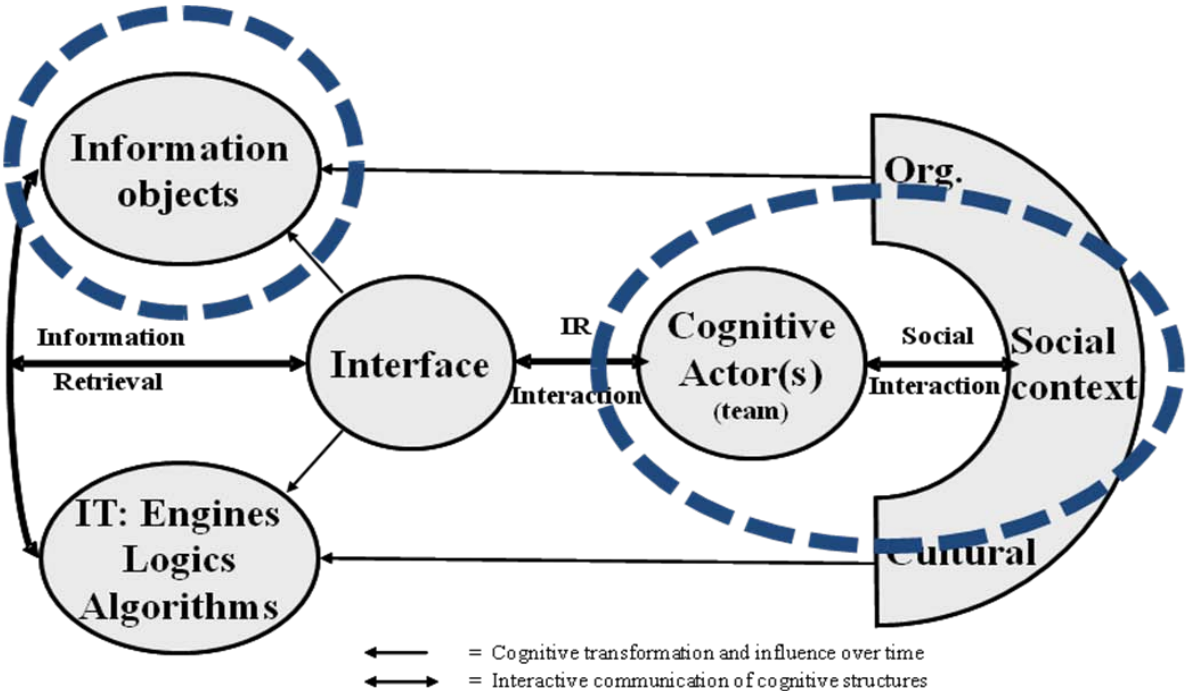

Figure 2.3: Interactive information seeking, retrieval and behavioural processes in a museum context. Generalised model of any participating cognitive actor(s) in context. Adapted from Ingwersen and Järvelin (2005, p. 261).

This section showed how the present information seeking study is positioned in a multidisciplinary intersection. Hence it supports the proposal by Järvelin and Ingwersen (2005) to turn information seeking closer to related research disciplines. As a consequence information seeking research may lose some of its independence but instead gain a better ability to communicate across disciplinary boundaries, thereby becoming more relevant in the eyes of others.

2.5.2 Participating cognitive actors: the case study

Above, the generalised context model is applied to illustrate different research areas included in the study. In this section a detailed and more complex version of the model, Figure 2.4, is applied to analyse the participating cognitive actors in the case study, exemplified by a scenario with the *professional museum curator* as the central cognitive actor. Figure 2.4 illustrates the five central cognitive actors and behavioural processes related to interactive information seeking and retrieval.

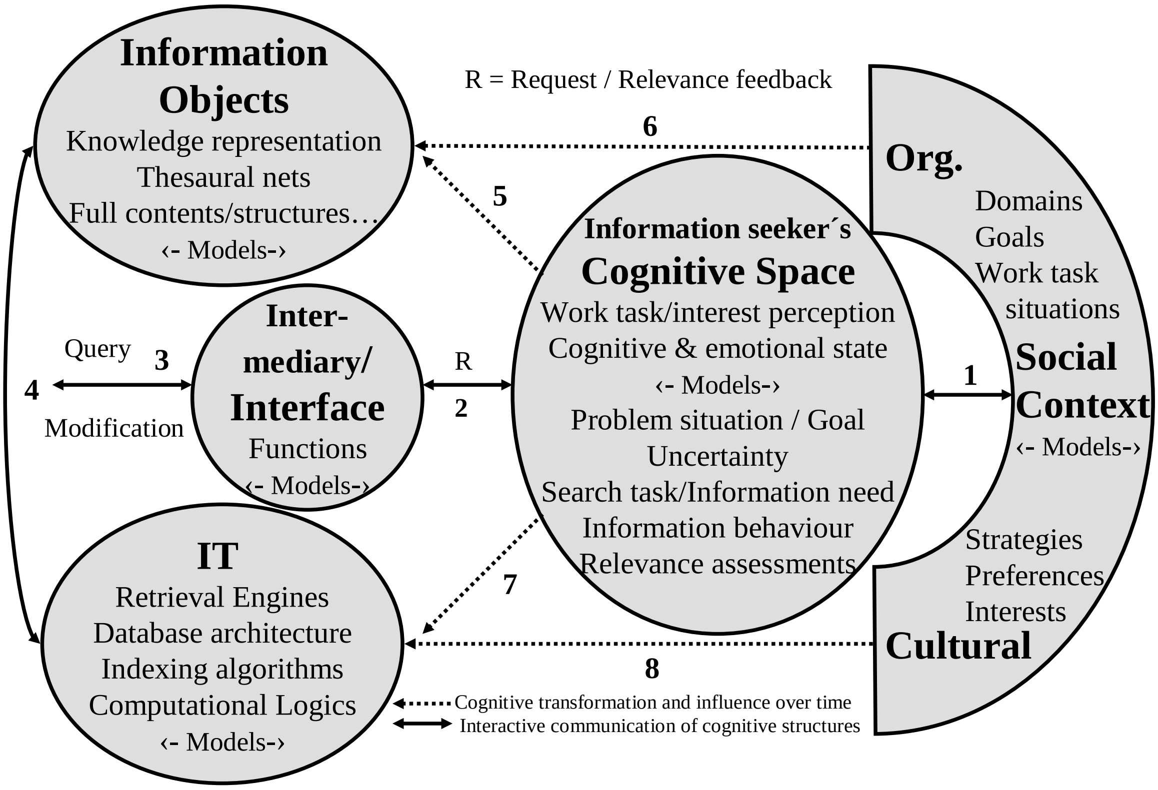

Figure 2.4: Interactive information seeking, retrieval and behavioural processes (Ingwersen & Järvelin, 2007, p. 274).

Each of the five central components consists of data structures representing the cognitive structures of the actors involved in their generation, maintenance and modifications over time. Through social interaction (arrow 1) the museum curator is influenced by his social-organisational or cultural environment. That is both his peer community in terms of past and present colleagues and friends as well as his ‘utility’ community, i.e., museum visitors. Depending on the perceived work task at hand, the museum curator may also interact with or influence the interface (arrow 2), the information space (arrow 5) and the IT setting (arrow 7). If, for example, the work task is cataloguing or resource description of museum artefacts, then the museum curator acts as *generator* of knowledge representations of existing information objects (arrow 5). Description of museum artefacts is at least partly a process of interpretation of existing objects and it is typically done according to both explicit rules and more implicit conventions influenced (arrow 6) by the professional domain and specific organisational practice (description of museum artefacts is discussed in section 3.1). Further, cognitive and emotional transformations and generation of potential information may also occur from the social, cultural or organisational context towards the IT component (arrow 8). Arrow 6 can for instance illustrate how domain characteristics affect cataloguing practice *over time*. Finally, the interface may interact with the system side (arrow 3), that is, the information space and the IT settings, and these two may interact as well (arrow 4).

This integrated framework is dynamic. Depending on the actor's role in information behaviour the central relationships between the cognitive components shift. When the actor role in focus changes, the contextualising actors change accordingly. To give an example: above, the professional museum curator represents the cognitive actor. However, if the focus of interest shifts to the *virtual museum visitor* as human cognitive actor then the Military Museum, including the curators, become part of the cultural context.

2.5.3 The research design cube: independent and dependent variables

The main strength of the integrated research framework is its illustration of the complexity of IS&R processes in a coherent and flexible framework. At the same time, a main challenge is the framework's general scope and the many components included. Firstly, the general scope suggests that in some cases the model must be supplemented with more detailed models focusing solely on, e.g., information seeking aspects. This point is also addressed by Saracevic when commenting on a earlier version of the model: "A potential weakness that remains is that the whole of information behaviour, as defined in other models examined in this paper, is subsumed under the heading of the 'user's cognitive space" (Saracevic, 1996). Accordingly, in the present study the generalised framework is supplemented by Vakkari's work on work task based information seeking (1999; 2001b). Secondly, the potential high number of components included in the framework easily result in a complex research design with many variables. The integrated framework does not dictate that research should encompass all of the five components and their interrelatedness and according to Järvelin (2007) no single study has done so. Instead the individual researcher should focus on specific components and their interrelatedness and bear the remaining in mind.

Within the integrated cognitive framework a variety of different research designs are possible involving few or many components and relationships. To help construct a powerful research design, Ingwersen and Järvelin (2005, chapter 7) introduce a multidimensional research design cube with five broad categories (the organisational task dimensions representing context, the cognitive actor dimensions, the information object dimension, the algorithmic dimensions, and the access and interaction dimension) and nine classes of variables that interact in IS&R processes.

Given the present study's aim and research questions the focus is on the following three dimensions: the *cognitive actor,* the socio-organisational or cultural *context*, and the *information objects* (marked with circles in Figure 2.3 above). This combination of dimensions is *not* described in Ingwersen and Järvelin (2005) and to the present author's knowledge no previous empirical applications of the integrative framework exists. Hence, the present case study illustrates and serves as a *novel* fifth case of application of the integrative framework.

Table 2.1 shows the independent variables (dark framed shading) and controlled variables (light shading) looked at in the present case study. Table 2.1 presents the design cube in two-dimensionality although there are five dimensions (as the actor dimension is divided into three dimensions). We investigate the interaction of actors and information objects in two different socio-organisational contexts: an organisational context of professional museum curators and a leisure context of hobbyists. The dependent variables (light shadings) in the case study relate to:

- Perceived information needs work of both professional curators and hobbyists;
- Actor characteristics of hobbyists in relation domain knowledge and actor's age; and
- Perceived work task complexity in relation to professional curators only.

The present research design also reflects the involvement of characteristics of documents and sources:

- Information types in documents;
- Human sources; and
- Document isness / metadata (in relation to hobbyists only)

The above combination of dimensions in the present case study reflects a research design in which the controlled dimensions are the *algorithmic* as well as the *interface* component. That is, the search engine and indexing algorithms are fixed, as is the interface component. These two dimensions together with all other variables (white background in Table 2.1) suggest potential hidden variables (Ingwersen & Järvelin, 2005, p. 366). For instance, data collection in relation to hobbyist was based on a self-selected sample (see section 5.4) which may suggest that the case study of hobbyists reflect only highly motivated hobbyists. Thus, the variable related to motivation as an actor characteristic may be a hidden variable – together with others.

Table 2.1: The research design cube. Illustration of independent (dark shading and bold) and controlled variables (light shading, bold and italics) combined in the present study. Adapted from Ingwersen and Järvelin (2005, pp. 356-357).

The organisational task dimension	**The actor dimension**			**The information object dimension**
Natural work (/leisure) tasks	**Actor characteristics**	**Perceived work tasks**	**Perceived search tasks**	**Document and sources**
WT structure	***Domain knowledge*** *Hobbyists only*	Perceived work task structure	***Perceived information need***	Document structure
WT strategy and practice	IS&R knowledge	Perceived WT strategy & practice	Perceived ST structure/type	Document types
WT granularity, size & Complexity	Experience on work tasks	***Perceived WT complexity*** *Professional curators only*	Perceived ST strategies & practices	Document genres
WT dependencies	Experience on search task	Perceived WT dependencies	Perceived ST specificity & complexity	**Information type in documents**
WT requirements	Stages in work task execution	Perceived WT requirements	Perceived ST dependencies	Layout & style
WT domain & context	***Age*** *Hobbyists only*	Perceived WT domain and context	Perceived ST stability	**Document isness (metadata)** *Hobbyists only*
…	Motivation & emotional factors		Perceived ST domain & context	**Human sources**
	…	…	…	…

3 Approaching a virtual museum context

The emerging field of museum informatics can be described as the study of how information science and technology affect the museum domain (Marty et al., 2003, p. 259). Several authors describe how new possibilities in information technology impact the museum domain. The possibilities go well beyond simple computer automation, raising fundamental questions about the experience of visiting a museum, and the very definition of what a museum and museum collections are (Marty et al., 2003; Parry, 2005). The field of museum informatics relates to the part of cultural heritage[11] located at museums. Museum informatics is an emerging, multidisciplinary research area strongly influenced by e.g. information science and museums studies (see section 3.2.3). Within the field of museum studies recent literature points to a changing role of museums in society (G. Anderson, 2004; Cameron & Kenderdine, 2007; Hooper-Greenhill, 1992). The changing role of museums in society encompasses a shift away from the idea of museums as repositories of objects to the notion that they are repositories of knowledge (Hooper-Greenhill, 1992) and providers of event-based exhibitions composed of many different artefacts and situational features. G. Anderson (2004) calls it a paradigm shift from museum as collection-driven institutions to visitor-centred museums. She describes a number of parameters capturing the essence of the traditional museum opposed to what she calls the *reinvented museum*. The traditional museum and the reinvented museum respectively can be characterised as follows: inwardly driven as opposed to responsive to visitor needs, one-way communication as opposed to two-way communication, keeper of knowledge as opposed to exchange of knowledge, and voice of authority as opposed to multiple viewpoints (G. Anderson, 2004, p. 2).

This shift of paradigmatic nature in the museum domain strongly influences the museum as an institution (including the work tasks of the employees), the role of the museum visitor and how collections are represented, indexed and organised (see Figure 3.1, p. 43). Museum informatics cannot be looked at in isolation and accordingly this

[11] Cultural heritage can be defined as the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations.

chapter discusses the elements of museum informatics within the light of the shift towards the reinvented museum.

The aim of the chapter is to provide background knowledge and explicate the challenges and possibilities within the museum domain in relation to description of and providing access to museum artefacts in a digital museum context. Firstly, the chapter starts with a historic view on knowledge organisation and indexing in the museum domain followed by a discussion of the museum artefact as an information resource. Secondly, the chapter discusses the merging field of museum informatics in a user perspective including dilemmas and different approaches to digitization. Finally, it seeks to characterise the elusive virtual museum visitor.

3.1 Knowledge organisation and indexing in the museum domain

The organisation and indexing of museum artefacts has always been a central issue for museum curators (Buck & Gilmore, 1998). Similar to other cultural heritage institutions (like e.g. libraries, archives, and galleries) museums have a long tradition of description and indexing of information objects as a fundamental element in collection management. These processes are considered part of knowledge organisation defined as:

> "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." (J. D. Anderson, 1997, p. 336).

Within a broader view knowledge organization concerns how knowledge is organized in, for example, scientific disciplines, higher educational institutions, encyclopaedias, languages, genres etc. In the following, a short historic perspective on museum documentation is offered in order to understand the current practice and knowledge organisation processes.

3.1.1 A historic view: from the order of classification to cultural complexity

The museum as an institution has undergone a long development reaching from the earliest museums of private collections to present day's rich variety of museums to be found in castles, boats, farms, dungeons etc. as well as in more traditional museum buildings. These changes are reflected in the museum's changing purpose and role through time and not least in relation to the role of the visitor. In this light it is interesting to consider a historic perspective on knowledge organisation and classification of museum objects. A historic perspective provides valuable insight as it offers a broader context for understanding today's knowledge organisation and indexing in museums. At the same time, since many museums possess collections assembled and described many years ago, the reminiscences are still visible and relevant in today's work with cultural heritage collections.

In her book on museums and the shaping of knowledge Hooper-Greenhill (1992) illustrates how interpretation of museum objects is shaped by the historic and cultural context within which they are displayed. Hooper-Greenhill's analytical work explicitly addresses elements of knowledge organisation and indexing. Based on Foucault's (1970; 1974) theories on three major *epistemes*[12] Hooper-Greenhill applies a long-term historic view. She describes how there have been radical shifts in what meanings have been made, how collections have been put together, and how theses collections, once constituted, have been used. *The renaissance episteme* covered the early years of museums and was characterised by a complexity of interpretation and similitude, and things being read for their hidden relationships to each other. Resemblance was never stable and consisted of endless relationships. There was, therefore, "… no real substance, and no means of verification. Legend, stories, and material things all offered possibilities for discovering likenesses and relationships. None could be discarded, as all were potentially 'true' " (Hooper-Greenhill, 1992, p. 15). *The classical episteme's* founding structure was that of order, through measurement and the drawing-up of hierarchical series. A two-dimensional table of classification emerged, and all natural things were arranged and grouped into families on the basis of their visible features. A thing became an object through its visible features. In the *modern episteme* objects are constituted through organic, historic links, through stories, and trough people: "In the

[12] Hooper-Greenhill analytical work is based on Foucault's (1970; 1974) theories on three major *epistemes*: the renaissance, the classical and the modern episteme. Foucault defines episteme as the

modern age, knowledge is no longer shaped by the secret, enclosed, circulating structures of the Renaissance *episteme*; nor by the flat, classificatory table of difference of the classical *episteme*; now knowledge is structured through a three-dimensional, holistic experience which is defined through its relationship to people" (Hooper-Greenhill, 1992, p. 214). Or in other words, the *context* of the artefact started to become important.

Hooper-Greenhill's analysis of the history of museums shows that the principles of selection, putting together a collection and classification have radically changed over the years. In 1992 Hooper-Greenhill, building on Foucault (1970), wrote that the end of the modern age was close to an end signalling the final of the modern museum. Ten to fifteen years later, G. Anderson (2004) and Cameron and Kenderdine (2007) do not hesitate to call it a paradigmatic shift, and G. Anderson describes and characterises the reinvented museum. In the reinvented museum the human, social, and cultural context of the museum artefact is central, leading to multiple viewpoints and potentially numerous perspectives (G. Anderson, 2004). Further, the reinvented museum does not represent a voice of authority but aims instead at being responsive to visitor needs and two-way communication. One may also say that the context of the visitor likewise becomes important, and that the museum is audience focused instead of collection driven. This process of rethinking the museum – reinventing the museum – can be said to symbolize the "…general movement of dismantling the museum as an ivory tower of exclusivity and toward the construction of a more socially responsive cultural institution in service to the public" (G. Anderson, 2004, p. 1).

In relation to this thesis, knowledge of the shift from the traditional museum to the reinvented museum is important, since the shift has influenced the area of study. Specifically, three areas should be pointed to. Firstly, the shift has led to changing perspectives on description and indexing of museum objects: "In the past, the object on display was accompanied with a label that fixed it in a monolinear frame of reference. A chair was 'Oak, Seventeenth Century'; a gun was identified by its firing capacity; […]. The human, social, and cultural contexts of theses artefacts were rendered invisible by these strategies. Now the many frames of reference that can contextualise material things are displayed along with the things themselves" (Hooper-Greenhill, 1992, p. 204-205). The quote illustrates a development in museum exhibitions closely connected to the shift from the traditional museum to the reinvented museum outlined above. In the

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unconscious, but positive and productive set of relations within which knowledge is produced and rationality defined (Foucault, 1974, p. 191).

reinvented museum artefacts are contextualised by human, social, and cultural references and these contextualised references must be captured in the registration and indexing process. The quote also illustrates a change from an order of classification to cultural complexity. Evidence of this change is reflected in the work tasks of the museum professionals in the case study (see section 6.2.1).

Secondly, the role of the museum visitor has changed and the information seeking behaviour of the today's virtual museum visitors must be viewed in this perspective. Hooper-Greenhill describes how, at the birth of the public museum, a division was drawn "…between the private space where the curator, as expert, produced knowledge (exhibitions, catalogues, lectures) and the public space where the visitor consumed those appropriately presented products" (1992, p.200). However, this cleft between the museum professional and the visitor has started to close. The opening process can be seen quite literally when visitors are invited behind the scenes on 'open days' and also in relation with the concept of open storage. Less literally but equally important are efforts to support direct visitor participation and involvement (e.g., Black, 2005) along with the shift from viewing museums as collection-driven institutions to viewing them as visitor-centred (G. Anderson, 2004).

Finally, new technology can be seen to play an important role in the reinvented museum. New technology provides new ways of communication and interaction with visitors. It is being used to reach new audiences; approach specific groups of users via tailored communication and as one way to fragment the meaning of the artefact by introducing many perspectives, voices and points of view. Museums have moved a long way from the birth of the public museum to today's reinvented museum (see also section 3.2.4 about improved access and social tagging and section 3.2.5 about the virtual visitor).

3.1.2 The museum artefact as an information resource

Museum objects without information about them have little more than aesthetic or curio value. For a group of objects to become a museum collection there has to be the intervention of the curator to produce and record knowledge about them. According to Orna and Pettitt museums select objects "…because they convey information. Artifacts, specimens, models, paintings, photographs and texts all are chosen because they convey information through their uniqueness or representativeness, their historical significance, or their aesthetic appeal (1998, p. 29). It is the complete systems that maintain this knowledge that give museums their ultimate value.

In the following, four main characteristics of the museum artefact as an information resource are discussed and relevant parallels are drawn to description and indexing of traditional textual resources to highlight differences:

1. *Highly heterogeneous collections.* Museum collections are often highly heterogeneous covering a variety of different types of media including three dimensional objects, text, photographs, sound, and video. The variety of different media challenges the uniformity of collection data since each media type requires tailor-made formats with specific fields. In addition, the passing of time may have introduced different approaches to indexing and registration, new information technology systems, and change in curatorial focus (according to section 3.1.1).

2. *Derived versus assigned data*. Description of three dimensional objects or visual resources is rather different from description of textual material as none or only few terms can be derived from the object. Instead data is assigned in the description and indexing process. Taylor explains it in the following way: “Description of visual material is often more difficult than description of textual material. There is more reliance on the perceptions of the person doing the describing. Often there are no words associated with items at all; it is necessary for the describers of such items to use their own words” (A. G. Taylor, 2004, p. 12). Use of primarily assigned data makes description and indexing a highly subjective task and the line between description and subject analysis is harder to draw.

3. *The inherent uniqueness of museum artefacts* remains an unsolved problem or challenge in relation to description of museum artefacts. According to Marty et al.: “No two museums can posses exactly the same historical object or work of art; even reproductions vary greatly in such crucial identifying features as size, material composition, and provenance” (1992, p. 266). The inherent uniqueness is partly due to the fact that museum artefacts are described in relation to a collection (whereas in libraries the ‘document’ is described as an individual unit). Two like objects – in two different museums – are part of different collections and contexts and will therefore be described and classified differently. Hence the meaning and significance of the objects will be correspondingly modified (Hooper-Greenhill, 1992). Especially in cultural history museums the concept of provenance (the unique history of the artefact)

is highly important and artefacts are often collected because they convey provenance information of historical significance. The inherent uniqueness makes describing each artefact time-consuming and a task difficult to share among institutions.

4. *The importance of context*. As a follow of the shift from the classical to the modern episteme (see section 3.1) the *context* of a museum artefact started to become important. Earlier collections, influenced by Linnean principles where e.g. animals and plants were grouped into species showing their family relationships through their placing, became almost valueless (Hooper-Greenhill, 1992; Mordhorst, 2005). Instead the human, social, and cultural contexts of museum artefacts have become important. The museum artefact itself is no longer the main interest, instead the artefact has become a mean to an end illustrating and representing a context (Mordhorst, 2005, p. 11). The importance of context brings along a high level of complexity as artefacts may have multiple contexts and changing relationships.

The four main characteristics of the museum artefact as an information resource show that the description of museum artefacts is in many ways more challenging than description of textual resources. Museum documentation consists of complex and unique information about objects infinitely more varied than ‘documents’. At the same time, the development of tools for automatic recognition and indexing of three dimensional resources is still in its infancy leaving description and indexing of museum objects a manual task.

The following two sub-sections describe how the characteristics of museum collections challenge two interlinked aspects of providing virtual access to museum collections.

3.1.3 Internal versus external view

Museum visitors’ virtual access to digital resources is challenged by a traditional internal view on museum documentation. As stated in the motivation, digitising cultural heritage collections involves opening up databases, previously the sole domain of museum professionals, to end users. However, opening up databases makes the collections available but not necessarily accessible.

Documentation efforts in museums are traditionally directed toward internal users (Chaudhry & Jiun, 2005; Trant, 2006). Diverse terminology sources are used (e.g. thesauri or other controlled vocabularies), which are often localised and highly specialised reflecting the professional jargon of the museum professionals. As a consequence several studies report on a mismatch between museum documentation and user needs (e.g., Chaudhry & Jiun, 2005; Orna & Pettitt, 1998; Stephenson, 1999; Trant, 2006). The mismatch can largely be explained by the following two factors:

- A *specialist perspective* on resource description. Museum documentation is traditionally written for and by museum professionals: “The knowledge organization systems that underlie museum documentation reflect specialist perspectives and museum business processes not public perceptions and interests” (Trant, 2006, p. 84).

- A *collection management perspective* on resource description with an internal focus (Booth, 1998; Orna & Pettitt, 1998; Stephenson, 1999; Trant, 2006). In a review of how museums populate fields in database records Stephenson (1999) found that museum data is largely created for collection management purpose and not public access, and as a result it has limited usefulness for open-ended searching.

A main explanation of this lack of connection between collection information management and documentation on one hand and access on the other hand can be found by looking at purpose and tradition of description. Hjerppe (1994) discusses the purpose of description within cultural heritage institutions and he identifies both similarities and differences. One significant difference is that descriptions in museums seek to add value to the artefact as a result of an *interpretation*. Whereas the main purpose of description in libraries is bibliographic control and retrieval. The process of interpretation connects to the fact that knowledge on a museum artefact is often incomplete when the artefact is purchased or collected. Complementary information can thus be added successively as a result of research. Whether research files are integrated within museums’ documentation systems differ. However, the point is that museum documentation has traditionally been used internal (communication with visitors has traditionally taken place through exhibitions) and opening up databases to end users is a major change. As a follow A.G. Taylor describes how “…curators may be reluctant to contribute some data because it may represent data created by individuals in the course of their research and may not yet be published” (2004, p. 11).

How museum artefacts are organised and indexed is influenced by both the museum as a systemic whole and the (end) users (see Figure 3.1). As described in this section, the influence from the museum, e.g. the museum professionals, curatorial approach and collection type, has traditionally been very strong due to the internal focus on description and indexing. Nonetheless, museum documentation and indexing is to some less degree also influenced by end users, as museum professionals assess what is needed for the use of potential museum visitors (Marty et al., 2003). As pointed to in the motivation, the recent trend of providing virtual access to cultural heritage collections stresses the need for a supplementary end user oriented approach to virtual museum collection (e.g., Booth, 1998; Chaudhry & Jiun, 2005; Stephenson, 1999; Trant, 2006). Several initiatives have started and also this thesis is motivated by the call.

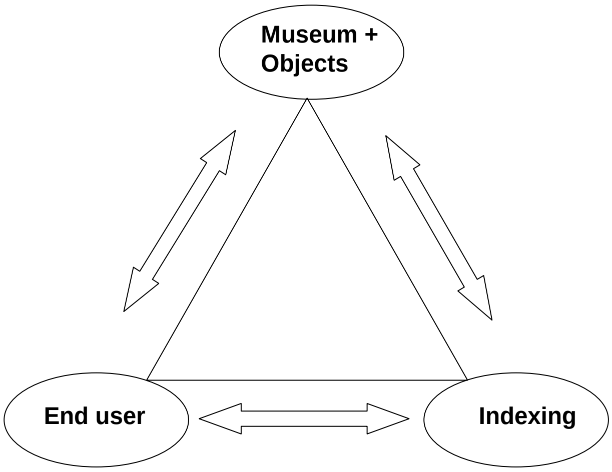

Figure 3.1: General model of how indexing is influenced by *and* influences both the museum and the end user.

3.1.4 Standards: a key to access

The inherent uniqueness of museum artefacts described above constitutes a challenge in relation to creating uniform and common standards for documenting museum artefacts. Likewise, the firmly held notion of unique artefacts creates a barrier to sharing the task of description and indexing among institutions.

Standards help institutions to document their collections according to a commonly shared model. Therefore the application of standards aims to support a homogeneously description of museum artefacts facilitating easier access to cultural heritage collections both within a single institution and across institutions. “The fact is, however, that cultural heritage institutions not only use a multitude of different standards, but in many cases they do not use any standards at all but still work with their own “native” data”

(European Commission. Directorate-General for the Information Society, 2002). Within the multitude of different standards a couple of major standards are widespread and have international impact, e.g., Spectrum[13] which is a standard for describing museum objects produced by the British MDA organisation[14]. Spectrum covers more than just the description of museum artefacts but also procedures in relation to collection management such as object entry, location and movement control, loans in and out etc. From an end-user perspective Trant (2006) comments on this focus on museum management functions in standards: “Subject access is not a core requirement for museum business functions (such as registration, inventory and location control, exhibition and loan management) and so is not a core requirement in museum documentation guidelines such as the MDA’s Spectrum […] or the CHIN Humanities Data Dictionary” (Trant, 2006, p. 87). Trant’s studies of social tagging within the art museum domain are hence motivated by the often lacking subject data and internal focus of museum documentation (see also section 3.2.4).

Recent year’s interest in joint museum projects aiming at seamless access to collections across institutions (see also section 3.2.4) has renewed the attention towards development of common standards. However, despite the activity and renewed interest, lack of commonly shared metadata standards is still the “biggest obstacles” to providing seamless access (European Commission. Directorate-General for the Information Society, 2002, p. 289) and Marty et al. add the following conclusion: “…it has proven difficult for museum professionals not only to agree on standards for inter-museum communication, but even to use those standards consistently in their own institutions” (2003, p. 268). Adding up, there seems to be a difficult trade off between the fear of loss of individual control, level of detail and local terminology on one hand and the adoption of standards to provide seamless access and participate in an exchange of data among institutions on the other hand.

[13] SPECTRUM: the UK Museum Documentation Standard. Available: http://www.mda.org.uk/spectrum.htm.

[14] For a thorough discussion of the development of museum standards see e.g. Marty et al. (2003).

3.2 Museum informatics in a user perspective

In the last decade, museums’ use of new technology, following the Internet revolution, has taken speed. One may ask *why* it is important to digitize museum collections. The answer is manifold and this thesis does not aim at giving a full, elaborated answer. A brief answer is, however, that in a global, multi-ethnic and fast changing world, knowledge on your own cultural background is valuable also in relation to shaping your personal identity. A parallel is reflected in an exponentially growing interest in family history and genealogy (Yakel, 2004). Another aspect of the answer connects to the shift towards the reinvented museum (see section 3.1.1), where the internet provides new ways of communication and interaction with visitors. Discussing digital access to cultural heritage resources, Cameron and Robinson (2007) conclude that the only solution for museums will be to commit to putting the key issues of digital collection documentation into practice and “…the reality is that museums […] have no choice but to remain accessible and inspiring to their audiences in order to remain viable” (2007, p. 187). Yet, a third aspect of the answer is, that museums in many ways are ideal content providers for the internet since they typically possess a large quantity of high quality content, and they have an established reputation for “…quality of information provision, objectivity, authority and so on” (Cunliffe et al., 2001, p. 229).

A number of obvious advantages can be attached to digitizing museum collections in a virtual museum context:

- The internet presents museums with a unique opportunity to reach both local and international publics in new ways: “For the first time museums are freed from their inherent localism, the physicality that requires their users to be in-person visitors” (Orna & Pettitt, 1998, p. 97).
- The virtual visitor can get close to the museum object and maybe zoom to see details or viewed from all angles using 3D technology.
- Museums can bring together in one place virtual representations of objects whose originals are geographically scattered.
- Due to physical limitations most museums have the majority of their objects on storage with only a small part on display. In a virtual context museums are not limited by physical aspects of e.g. very room-demanding or fragile artefacts.
- It is possible to target communication to specific groups of visitors (e.g. school children at different levels, teachers, researchers, or the lay audience). For example, the concept of life long learning is increasingly the norm and providing resources will offer many opportunities for museums.

Despite the list of obvious advantages, digitization of cultural heritage collections also brings along dilemmas, showing the complexity of museum informatics.

3.2.1 Three dilemmas of digitization in cultural heritage

In this section, three dilemmas of digitization in cultural heritage will be addressed: the dilemma of representation, the authority dilemma, and the dilemma between providing access and 'disneyfication'. A discussion of the three dilemmas points to some of the challenges involved in digitization. Further, it touches upon themes uncovered in the empirical data from the case study.

The dilemma of representation centres on the status between the *original* museum object and the *copy* (whether digital or not). Most museum objects are not "born digital"[15] and therefore remediation occurs when the object is digitized and turned into a digital representation of the original, physical object. Traditionally, the main characteristic of museums is the collection and display of original, authentic, and physical artefacts. The theorist Walter Benjamin argues that the original art works have an *auraic* presence defined as the "…essence of all that is transmutable from its beginning, ranging from its substantive duration to its testimony to the history which it has experienced" (Benjamin, 1970). Because of the material authenticity and auraic presence we still visit the Louvre, even though we can view a picture of Mona Lisa online. And we pay visits to the Roman Colosseum, the crown jewels etc. Theorists like Benjamin (1970) and more recently Baudrillard (1996) represent an object-centeredness and repugnance for reproductions. Cameron (2007) argues that Benjamin and Baudrillard are positing the digital object as 'terrorist' when arguing that "…mechanical reproduction and more recently simulations pose a threat to the "real" object and works of art leading to the loss of their auraic, iconic, and ritualistic qualities (2007, p. 50). The 'terrorist' is also seen potentially to challenge central museum concepts such as the collection, thus undermining museum culture and practice. A contrasting view is expressed by Witcomb (2007), who seeks to redefine object-centered museum culture and instead posits museums primarily as information sources rather than repositories for

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[15] Galloway (2004) distinguishes between born-digital objects and non-digital original objects, which are digitized for preservation and/or access reasons. New challenges in relation to born-digital objects have in recent years occurred, especially in art museums, as more works of art are either digitally produced or digitally supported.

objects. This view can be seen to reflect G. Anderson's (2004) description of the reinvented museum, which is moving away from a collection-driven approach (see section 3.1).

The discussions on *aura* in the museum literature show a dispute between researchers who grant digitally reproduced objects a kind of auratic quality and those who refuse to grant it. Essentially, the representation dilemma leads to the question whether it is possible for visitors to have a meaningful or 'real' experience visiting a virtual museum (Schweibenz, 1998).

The authority dilemma relates to how digitization potentially blurs the boundaries between the museum and the public. Digitization involves opening up databases to end users and publishing of museum documentation previously the sole domain of the museum professional. In a virtual museum context the end user is free to navigate and follow his own paths, and is no longer directed by the choices and views expressed in carefully designed exhibitions: "Accustomed to controlling every aspect of in-house exhibits, museum professionals fear losing control over the context in which museum artefacts are viewed in the online world (Marty et al., 2003, p. 281). Likewise, the virtual dissemination of information makes it impossible to maintain control of how information and photographs are re-used in new contexts. The break through of social technologies like e.g. social tagging[16], folksonomies, and wikipedias can also be seen as a threat to the museum as an authority. Letting 'just anybody' play a role in collection description, a prime professional role of the museum, can be seen to undermine the authoritative role of the museum and the result might be 'wrong information' (Trant, 2006, p. 87).

Finally, the third dilemma is between *access* and '*disneyfication'*. Like other cultural heritage institutions museums are influenced by the experience economy (Skot-Hansen, 2008) and a growing demand for integrating entertainment and leisure elements in traditional services. "As shops take over gallery spaces, museum exhibits are returned to storage, and items for sale take their place […] Museum visitors as lookers and learners are repositioned as consumers (Hooper-Greenhill, 1992, p. 202). Parallels can be drawn to the virtual museum. In a large-scale study of web information behaviour Nicholas, Huntington and Dobrowolski (2006) name the end-user a consumer and characterise information behaviour as far more horizontal when traditional services are being

[16] Social tagging defined as "the collective assignment of keywords to resources" (Trant, 2006, p. 83).

juxtaposed with entertainment and leisure. Further, information seeking is not necessarily purposive. Instead they describe a form of behaviour more common in the media and entertainment worlds than in the world of university libraries: "In our logs, we see people searching for fun or entertainment, because they are bored, or to obtain stimulation or simply just wish to feel in touch or connected" (Nicholas et al., 2006, p. 204). The third dilemma can be characterised as a balance between attracting visitors to the (virtual) museum in a highly competitive marked of entertainment and leisure activities *and* communicating high quality knowledge based on professional practice and research.

The three dilemmas stress the need to reflect upon the consequences of digitization in cultural heritage. Further, the dilemmas raise fundamental questions like: will the physical object become less significant? And will differences between surrogate records and authentic artefacts become less and less significant. The empirical data from the case study reflects upon aspects of the representation dilemma, both in connection with the professional curator as to the question of what constitutes 'a good museum object', and in connection with the virtual visitor as to the context and purpose of visit. The following section addresses a fourth dilemma. It is not a dilemma of the consequences of digitization as such. Instead it concerns how and what to digitize. Choices have to be made.

3.2.2 Critical versus mass digitization

A continuum of approaches to providing access to information on museum artefacts online can be identified. It is a continuum ranging from modest online brochures to elaborate virtual museums. Dahlström and Hansson (2008) propose a useful distinction between quantitative (or mass) and qualitative (or critical) digitization to help strengthen scholarly analyses of digitization practices within cultural heritage. Mass digitization aims to digitize massive amounts of 'documents'[17] using automated means: "For pragmatic reasons, mass digitization has to disambiguate the transmission phases, minimize interpretation and flatten out the digitization process into a two-dimensional linear affair" (Dahlström & Hansson, 2008, p. 111). Critical digitization is a more exclusive strategy involving "…deep text encoding, critical image and text editing, and

[17] The term 'documents' can be understood in a broad sense also to include representations of artefacts, photographs etc.

rich information assignment to critically selected documents” (Dahlström & Hansson, 2008, p. 111). The latter approach involves intellectual, interpretative and multi-faceted measures and the output is an enriched, interpreted, new object and not just simply a clone of the analogue source.

Dahlström and Hansson (2008) address cultural heritage with focus on practice and examples within libraries. When applying the concepts to the museum domain the distinction between mass and critical digitization has to be taken a step further by adding a second dimension concerning the degree of virtual uniqueness. Degree of virtual uniqueness is a continuum between approaches of reproduction of museum collection databases or exhibitions in the physical museum *versus* unique, born-digital resources produced specifically for a virtual museum context and using the possibilities provided by the medium. Dahlström and Hansson (2008) include this second dimension within the distinction between mass and critical digitization. They regard the output of mass digitization as a clone or reproduction of the analogue source, whereas the output of critical digitization is regarded a changed and new object. However, an inexpensive and often seen digitization approach in the museum domain is to (more or less) duplicate an exhibition from the physical museum (Ex4 in Figure 3.2). Such an approach cannot be categorised as mass digitization, as the exhibits are traditionally critical selected and assigned with exhibition texts of rich and mediated nature. These characteristics seem incompatible within one dimension leading to the proposal of the second dimension. Adding the second dimension also highlights the importance of taking advantage of and exploring the possibilities provided in a virtual museum context (Ex3 in figure Figure 3.2) instead of duplicating material in the physical museum, which according to Hertzum (1999) is a characteristic problem.

The distinction between mass and critical digitization coupled with the proposed second dimension is illustrated in Figure 3.2. In addition, the typical nature of information provided within the continuum is added along the horizontal axe in Figure 3.2. Orna and Pettit’s (Orna & Pettitt, 1998, pp. 34-35) terminology is used:

1. *Raw information* is the primary written information available when an object enters the museum. Raw data is found in accession books, field notebooks as well as it is the information extracted by detailed examination of the object;
2. *Refined information* is raw information converted and made more accessible to a wider audience; and
3. *Mediated information* is a result of a process of extraction and interpretation of the refined information. The mediated information can be used by an even larger group of people, both in a scholarly and ‘popular’ context.

For raw information to be converted to either refined or mediated information, some kind of indexing (either human or automatic) takes place.

As described earlier a part of the case study in this thesis concerns how virtual museum visitors seek information in the Military Museum’s online catalogue (a presentation of the museum catalogue is provided in section 5.2.2). Shortly characterised the Military Museum’s online museum catalogue consist of extended catalogue information on 1800 museum artefacts. A record for each artefact contains catalogue information, photograph (zoom function available), and additional, narrative information extracted by detailed examination of the artefacts. This textual description contains both provenance information and a detailed physical description. In addition many of the records have scanned extracts from accession books attached. As a whole the catalogue data in the Military Museum’s online database can be described as *refined information*, as mediated layers of information are not added to the records (see how the case study is placed within Figure 3.2). On the vertical axe in Figure 3.2 the case study can be placed somewhere in between (but closest to ‘reproduction of physical collection’), as the online database is partly an analogue copy, but provided with additional photographs, a zoom function and alternative, thematic access points. Figure 3.2 gives four examples of different approaches. In example one and two raw information without any refinements or indexing is used. It can both be analogue registration material or photos which are digitized (example 1) or born-digital resources like digital photos (example 2). An example from the case study related to the latter is photo recordings from F-16 military aircrafts. As we move from mass digitization to critical digitization more and more layers of refined and mediated information are added. Traditionally the information is added by museum professionals, but user based tagging is equally a way of refining information. Example three and four illustrate critical digitization. The most common example of Ex3 is internet art (e.g., Greene, 2004) or other art works digitally produced. A fictive example of Ex3, in relation to the present case study, could be animated battle maps or virtual battlefield tours. Finally, example four is typically a reproduction of an exhibition in the physical museum.

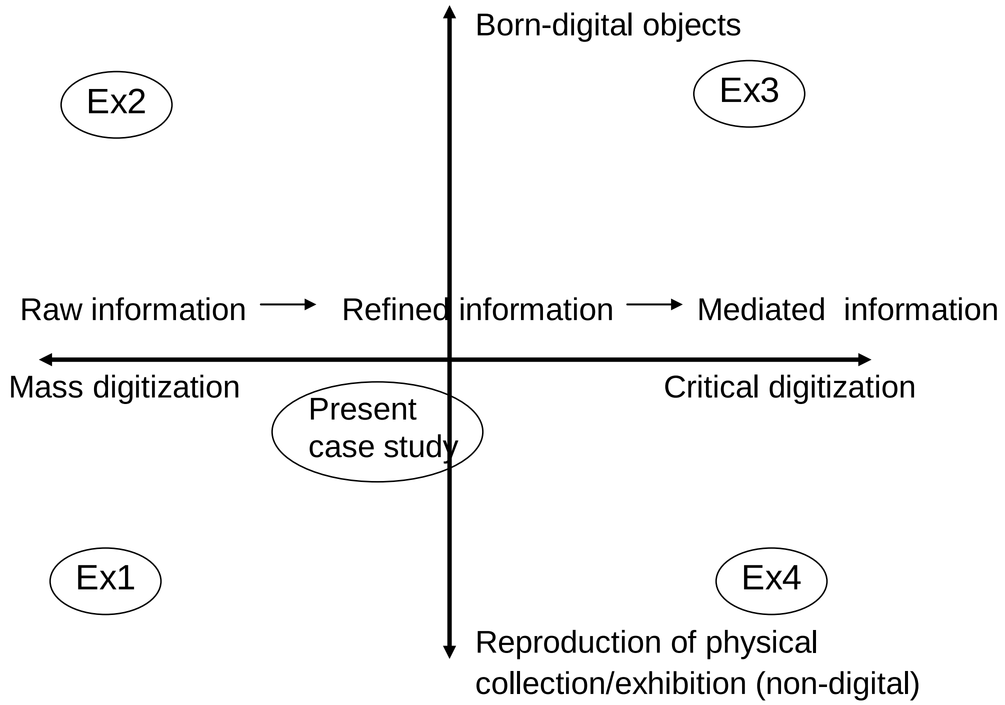

Figure 3.2: Digitization strategies: mass versus critical digitization

Legend: The figure illustrates the continuum between mass digitization and critical digitization (horizontal axe) and the continuum between products of digitization which are uniquely virtual and reproductions of physical collections or exhibitions (vertical axe). The figure is based on Dahlström and Hansson's (2008) distinction between mass and critical digitization and is further extended by adding a second dimension.
Ex1: e.g., an online museum catalogue providing access to registration data, photographs (without metadata) etc.
Ex2: digital objects like digital photos (without metadata)
Ex3: e.g., a unique virtual resource produced specifically for a virtual museum context and using the possibilities provided by the medium. For example internet art or
Ex4: e.g., a reproduction of an exhibition in the physical museum

When applying the distinctions between mass and critical digitization, it is important to avoid creating a false dichotomy between mass digitization as insufficient and critical digitization as the ideal. Instead the two approaches each contribute with different advantages, and obviously the choice of approach should reflect the particular collection, available resources, and aimed user group. For instance, mass digitization approaches can result in an overwhelming amount of information of excessive and fragmentary nature. This is potentially a problem, since, according to Cameron and Robinson (2007, p. 179), many users do not want to take full responsibility for the interpretive process and continue to look to the museum to provide trustworthy, authoritative, and meaningful scholarly information. From a contrasting perspective, due to the less resource demanding methods, mass digitization approaches give access to a much wider selection of information letting the end-user make his own choices without being restricted by the choices made by an intermediary, authoritative expert.

The dilemmas and different approaches discussed in this and the former section show a range of fundamental questions arising when studying the museum domain through a lens of information science and technology.

3.2.3 The emerging field of museum informatics

As written in the beginning of this chapter the emerging field of museum informatics can broadly be described as the study of how information science and technology affect the museum domain (Marty et al., 2003, p. 259). The field of museum informatics started to take form in the late 1990s, when extensive literature on museums and information technology (e.g., Keene, 1998; Orna & Pettitt, 1998) and literature on how museums have been influenced by technology (e.g., Jones-Garmil, 1997) were published. Also during the 1990s a couple of conferences emerged covering areas of museum informatics. For example, the International Cultural Heritage Informatics Meetings (ICHIM) appeared in 1991 and in 1997 the first 'Museums and the Web' conference was held. The purpose of the broad in scope 'Museums and the Web' conference is to facilitate exchange of information about museums' presence at the web. The conference has become a huge event and attracts many participants from mainly museums. Due to the multidisciplinary nature of museum informatics (see below) a number of different journals touch upon issues of the field. To mention a few examples, a special issue of the 'Journal of the American Society for Information Science' (Bearman & Trant, 2000) and likewise a special issue of the 'Bulletin of the American Society for Information Science and Technology' (L. White, 2004) were devoted to museum informatics. Finally, in 2003 the first 'Annual Review of Information Science and Technology' (ARIST) chapter on museum informatics was published (Marty et al., 2003) and provided an extensive review and discussion of the field.

In the present thesis Marty et al.'s (2003) term 'museum informatics' and the definition above is used. However, a closely related term is also observed. The term 'digital cultural heritage' was introduced by Parry (2005) as a new area of research[18]. This emerging field focuses on the relationship between technology, theory and the museum in a critical perspective. Parry (2005) is concerned with avoiding the so-called *technology trap* and therefore supports the emergence of a more sociological and theorised readings of museum computing. A strong parallel can be seen to the broad and narrow perspectives on museum informatics respectively (see below). It remains imprecise whether the two emerging fields of museum informatics and digital cultural heritage are actually *one*, which is defined and explained almost simultaneously by different authors. Indeed there are strong parallels and overlaps but also differences as digital cultural heritage places great emphasis on applying sociological and historical perspectives. The discussion reflects the novelty and the multidisciplinary nature of the research area.

Museum informatics is a sub discipline of museum studies (or museology) which has a long tradition as research area and can be defined as the study of the purposes and organisations of museums (Burcaw, 1997). Museum informatics can be described as a *multidisciplinary area of research*; building on museum studies but it also draws upon many related areas as e.g. social informatics, digital libraries and information science (Marty et al., 2003).

In a *narrow* sense museum informatics is about technical processes of computer automation and digitization in museums. In a *broader* perspective it acknowledges that information technology in museums cannot be looked at in isolation, as technical issues are "…nested within complex and interlocking organizational and social contexts that affect both the nature of museum work and expectations of the museum's clientele (Marty et al., 2003, p. 261). Accordingly, museum informatics studies can be undertaken from *multiple perspectives* resulting in a broad diversity of studies. The multiple perspectives include:

- An end-user perspective: for example the experience of visiting a (virtual) museum (e.g., Cunliffe et al., 2001; Marty, 2000) or addressing virtual

[18] Although the term 'digital cultural heritage' is seen used before 2005 it has mainly been in relation with digitization projects and not necessarily within a research perspective.

museum visitor behaviour like, e.g., Kravchyna (2004) and the present thesis, both with focus on information seeking behaviour.

- A museum professional perspective: e.g. the changing role of museum professionals reflecting a change in the complexity of information resources (Marty, 2007).
- A theoretical perspective: e.g. placing of museum informatics into critical contexts informed by theory on digital cultural heritage (e.g., Cameron & Kenderdine, 2007; Parry, 2005).
- A learning perspective focusing on e.g. how new technology can enhance projects on life long learning.
- A museum, library and archive (MLA) perspective about collaboration and integration of access to collections in the three related types of institutions (Gibson, Morris, & Cleeve, 2007).
- A technological perspective often combined with one of the above perspectives (see also 3.2.4).

The above list shows a variety of perspectives on exploring the interactions between people, information, and technology in museums. Many interests are in play and the perspective often depends on "who is in the driver seat". From an *information seeking* point of view it is evident, that while studies of information seeking behaviour, information retrieval systems and metadata have a long tradition in information science, such research studies are at an early stage in the museum domain (Kravchyna, 2004, p. 2). One explanation of why information seeking has received little attention is that the notion of user and use is not prevalent. Instead museums traditionally provide experience and communicate through exhibition, "…and 'expert-led' storytelling through narrative arrangement of objects remains a priority" (Chan, 2007, p. 1).

Section 3.2.5 examines a selected group of studies on virtual museum visitors, which shows the little attention given to elements of information seeking. But first section 3.2.4 aims at giving an overview and examples of how new technology has influenced and contributed to improved access to cultural heritage in the museum domain.

3.2.4 Museum informatics: improved access and social tagging

Within the narrow sense of museum informatics, the technical processes of computer automation and digitization, new technology has in general terms meant faster access to more and more resources. Improved quality of e.g. the process and outcome of scanning documents including word recognition and digital images has without doubt enhanced access to cultural heritage resources. However, it is when looking at the broader perspectives of museum informatics one sees the major developments and implications, which new technology potentially bring along.

The following three examples are chosen to illustrate how technical issues are nested within and influence the social context of both museum work and the experience of a virtual museum visit[19].

Social tagging and user involvement: Social tagging is one of a number of internet-based technologies museums have used to encourage public engagement with their collections. Within a social tagging framework users are enabled to use personal keywords (tags) or narratives to define the significance of museum artefacts. According to Bearman and Trant social tagging appeals to museums because it emphasizes individual meaning-making as central to personally significant encounters online: "tagging represents a dialog between the viewer and the work, and the viewer and the museum" (Bearman & Trant, 2005, p. 85).

Several museums have used social tagging and folksonomies[20], the most notably being the "steve project" at The Metropolitan Museum of Art (Bearman & Trant, 2005; Trant, 2006). The "steve project" was motivated by a lack of public perception and interests in museum documentation and explored how tags assigned by users could help bridge the semantic gap between the professional discourse of the curator and the popular language of the museum visitor. Results from the ongoing "steve project" show that non-professionals can supply useful new access points and hence augment the professional descriptions of museum collections. Further, early tests show that participants in the "steve project" found tagging engaging. Likewise, results from a similar tagging project in the Powerhouse Museum in Australia (Chan, 2007) show that user tagging and folksonomies can be used to improve navigation and discoverability but work most effectively when matched with detailed collection records.

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[19] Due to the thesis' focus on virtual museum visitors, the three examples illustrate new technology in relation to *remote* virtual access. However, new technology like e.g. handheld personal digital assistants (PDAs) has also opened new possibilities of personalisation of the museum visit in the physical museum (Marty et al., 2003, p. 277).

[20] When user tags are collected together they form a folksonomy; a dynamic, community-created classification system (Chan, 2007).

Social tagging is one way to encourage public engagement and it has the potential of changing the role of the virtual visitor from being a passive user of information to an active contributor. At the same time, social tagging challenges the authoritative voice of the museum professional hence touching upon the authority dilemma discussed earlier (section 3.2.1).

Secondly, *providing seamless access* to museum collections still constitutes a challenge since many museums have collection information distributed in multiple database systems. The challenges grow when aiming at providing seamless access across different institutions with individual local data and principles. Researchers have approached the challenge through different perspectives. From an information retrieval perspective, e.g., Arampatzis, Kamps, Koolen, and Nussbaum (2007) have approached the problem by extracting heterogeneous metadata descriptions from various systems (within *one* museum), converting the data to XML format and creating a unified system with the combined data. Another information retrieval approach is applied by Bellavista, Caorradi and Tomasi (2000), who have explored the potential for mobile agents to access distributed sets of heterogeneous data by querying thousands of museum information records remotely and consolidating the results. Both examples illustrate how information technology can improve access to heterogeneous collection data both within and across museums.

Finally, *improved access* to virtual museum resources can also be supported by various tools like taxonomies and ontologies to help users formulate and refine searches and navigate through the information space of concepts that have been used to index the collection. Like above, the aim is to create seamless access but instead of information retrieval techniques, knowledge organisation approaches are applied in the shape of different controlled vocabularies. Studies show how taxonomies can be used to organise diverse, unstructured and poorly described cultural heritage resources and provide a mediated interface between indexed collections and users who may be unfamiliar with the professional terminology (Chaudhry & Jiun, 2005; Tudhope & Binding, 2004). Likewise, ontologies have been used to create knowledge models for the cultural heritage sector (e.g., Hyvonen, Salminen, Kettula, & Junnila, 2004) both to support search engines and semantic browsing.

In total the emergence of a new field of museum informatics can be seen as a consequence of how new information technologies are changing museums' capabilities on one hand (Marty et al., 2003, p. 286), but on the other hand the emergence equally reveals a need to discuss and reflect on these changes within a theoretical framework.

3.2.5 Understanding the virtual museum visitor

This section seeks to characterise the virtual visitor based on a review of existing museum visitor studies. The review focuses on elements which can add to a characteristic of the virtual visitor's information seeking behaviour. While there is a large corpus of visitor studies in the physical museum world, studies on virtual visitors are more widespread and diffuse. At the same time the virtual visitor is elusive and harder to characterise than the physical visitor. This raises the relevant question of whether parallels can be drawn between the virtual and physical visitor: "Indeed, although it may appear tempting simply to assume that virtual visitors will have the same characteristics as physical visitors, this has yet to be established and there are many reasons to doubt such a straightforward equivalence" (Cunliffe et al., 2001, p. 232).

Despite this warning against drawing parallels, we first turn to visitor studies in the physical museum. It is beyond the scope of this thesis to go beyond a basic understanding of visitor profiles and behaviour in the physical museum. However, a basic understanding may help explain characteristics of virtual visitors' behaviour. In a recent book on museum visitors and visitor involvement by Black (2005) some general perspectives are identified. Reports from studies in England and Australia reveal that the broadest areas of interest within visitor studies are visitor satisfaction followed by basic attendance, postcode data and visitor socio-demographics (Black, 2005, p. 10). The information recorded is largely to meet the needs of marketing initiatives reflecting how important it is to museums to attract visitors. According to Black the "…most striking evidence from visitor surveys, revealed by any analysis of adult museum visitors, is that the largest group and the most over-represented in comparison to their percentage within the general population, consists for the better educated, more affluent, white professional classes" (Black, 2005, p. 18). Besides data on demographics and socio-economics many visitor surveys will also seek to look at the impact of the museum visit, exploring visitor satisfaction, motivation, learning and other potential elements that can be measured to reflect museum policies.

Addressing visitor motivations and expectations is specifically interesting as it can provide information on the *context* of the museum visit and hence also the context of information seeking behaviour in virtual museums. Black (2005) finds that the importance of learning in some shape has received overwhelmingly emphasis in the museum-led literature. Yet people have many reasons for choosing one leisure activity over another and therefore he suggests applying a broader perspective and viewing the museum visit in a 'social recreational context' where visitors are motivated principally by *personal interests*. In a survey work at the Science Museum in London, McManus

(1996) explored visitors' motivation for that specific visit and the associated expectations of the visit (see Table 3.1). Like Black (2005) she concludes that visitors are motivated by personal interest. Her findings on motivation and expectations also support a social recreational context of the visit. Comparable figures from the present study are presented in section 7.1.1.

Table 3.1 Motivation to and expectation of visits to museum. Findings from a visitor survey at the Science Museum, London (n = 100). Source McManus (1996, pp. 59-60).

Motivation to visit:	**%**	**Expectation of visit:**	**%**
Family visit with children	20	Finding out/learning	26
Recreation	20	Fun	22
Reputation of the museum	18	General interest	21
Interest in science	17	Specific aspect of museum	18
Revisiting the venue/ an exhibit	17	No structured plans	7
Museuming[21]	8	None defined	6

Booth (1998) provides an analysis of information needs at the Science Museum in London. Booth's analysis is very extensive and builds on consolidated evidence from different information surveys undertaken at the museum (including interviews, focus-groups, and analysis of enquiries). Based on the different surveys he constructs a comprehensive picture for visitor information needs and identifies the following three general groups of visitors and information needs (Booth, 1998, p. 150):

- The general visitor who requires information on opening hours, prices, the Museum's facilities, what's on, notable exhibits and navigation aids in the Museum.
- The educational visitor who requires more detailed information to help plan visits to the Museum and project-based information.

[21] McManus (1996, p. 60) explains that as the Science Museum is located in a museum district, a small percentage of visitors can be expected to be in the building because they are 'museuming' and making many museum visits that day.

- The specialist visitor who requires detailed information concerning the Museum's collections and access to its expertise, together with links to other sources of information.

Further, Booth (1998, p. 153) identifies a need for a variety of facilities including the following three remote access facilities:

- Remote access facilities to assist in planning visits (information on opening hours, prices, events, facilities etc.)
- Remote access facilities to meet technical enquiries (require information to be derived from bibliographical or object-related resources).
- Remote access facilities for virtual visitors who like to browse the galleries, see images of objects, and find out about those objects and related information).

Booth's study is interesting because it draws on extensive empirical data collected by a variety of data collection methods and it provides parallels to virtual museum visitors. Hence it complements studies of virtual visitors which primarily are based on web surveys (see below).

Finally, studies of visitor behaviour in the physical museum support the hypothesis presented in the first chapter about the explorative nature of virtual visitors' seeking behaviour (e.g., Borysewicz, 1998; Graf, 1994; Semper, 1998; Treinen, 1993). Graff concludes "…that most visitors [to museums] do not want to study in a goal-oriented, systematic manner" (1994, p. 79). Visitors do not necessarily want to learn in the museum but rather move around browsing the exhibits and therefore people's behaviour in museums can be regarded as synonymous with sightseeing or window-shopping (Graf, 1994; Semper, 1998; Treinen, 1993). Similarly, Borysewicz describes visitor behaviour as a process of "…moving from attractor to attractor, not always adhering to the programmed march exhibit designers intend for them" (1998, p. 114). He compares this behaviour with the way people use media programmes. "[B]rowsing through a CD-Rom or a web-site is strikingly similar to the 'grazing' behaviour that museum visitors engage in" (1998, p. 115). 115). The mentioned studies take place in the physical museum and it yet has to be established whether the explorative behaviour also can be identified in a virtual museum context.

As mentioned in the beginning of this section, studies on virtual visitors are widespread and diffuse. Many of them (e.g., Griffiths & King, 2007; Turner, Bertrand-Gestaldy, &

Bergeron, 2005) are mainly descriptive, based on internet surveys and focus on demographics, user satisfaction, defining of user groups, and/or frequency of visits. These surveys tell us about who the visitor is but leaves many questions unanswered: "In many 'visitor studies' of museum web site users, there is too much emphasis on who they are and too little on what they want and do on-line and the context in which they do it" (Peacock & Brownbill, 2007). In addition to the above, we need to understand their visiting in terms of purpose and context of visit, information needs, what they are looking for and how online collections are searched in order to characterise virtual museum visitors' information seeking behaviour.

The following review of four virtual museum visitor studies seeks to add to our understanding of the virtual museum visitor and, if possible, provide characteristics of the visitor's information seeking behaviour. The four empirically based studies are chosen because each of them contributes with valuable data on information needs, seeking or behaviour.

In the first study[22] *Chadwick and Boverie* (1999) examine the social context of virtual visitors. While most visitors to the physical museum come as part of a social group (Falk & Dierking, 1992), Chadwick and Boverie (1999) report that 69.8% of virtual visitors were visiting on their own, with family groups accounting for 21.6% and other groups making up the remainder. A similar percentage of collaborate online visitors were found by Goldman and Schaller (2004). Further, Chadwick and Bowerie found a statistically significant difference between the number of pages visited by groups and individuals, with groups tending to access more, but no significant difference in the duration of a visit. They also found that those visiting as part of a group are much more likely to say they are visiting to learn something rather than just engaging in some browsing activity.

The study reported by *Thomas and Carey* (2005) examines the link between visits to the virtual and the physical museum. It confirms that there are links between on-line and in-person visits and museums with online collection information and images will not reduce visits to the physical museum. Another interesting finding is that interest was highest in general information about the museum (58%), schedule of special events

[22] The study was conducted as a web survey at the New Mexico Museum of Natural History and Science web site.

(56%) followed by rich content such as collection-related information (49%) and virtual exhibitions (36%).

Like Thomas and Carey (2005) also *Kravchyna* (Kravchyna, 2004) investigates the link between visits to the virtual and physical art museum. She supports Thomas and Carey's (2005) findings indicating that virtual representation of museum collections do not jeopardize museum visitation. However, above all Kravchyna's thesis is interesting as she explicitly focuses on information needs of five user groups (general visitors, museum staff[23], students, teachers, and scholars). For the first three mentioned user groups the top three primary purposes for using a museum web site are: 1) to determine what to see in a museum, 2) to gain knowledge about a museum collection, and 3) to check calendar of events. This is not surprising since a primary purpose for teachers was to look for educational materials and for scholars it was important to find specific images. In total the findings of the web survey suggested that the five user categories have many similarities in their information needs:

> "There is no need to build separate Websites for general visitors and for scholars. All selected five user categories have many similarities in their information needs. Regardless of occupations, all user categories have similar primary purposes, similar preferences for types of exhibits and information about exhibits, information about an artwork and multimedia preferences" (Kravchyna, 2004, p. 121).

This conclusion is surprising given the number of studies (e.g., Black, 2005; Booth, 1998) focusing on targeting information and exhibits towards different visitor groups. Kravchyna's conclusion stresses the importance of complementing descriptive web surveys with qualitative approaches, which to a larger extend can provide explanatory factors and a context of the findings.

Finally, also *Goldman and Schaller* (2004) explore issues of motivation and context of virtual museum visits. In line with the survey of virtual visitors in this thesis, Goldman and Schaller tried to capture individuals who could be looking at the web site for a content-based reason, excluding the large numbers of people who visit a virtual museum for the hours and admissions etc. Accordingly, the top motivation was searching for information about content (20.4%), followed by thinking the web site might be an

[23] In Kravchyna's study 'museum staff' is external museum staff visiting other museums' web sites.

interesting place to explore (17.3%). They also explored a variety of factors related to motivation. Only two factors showed statistically significant correlations namely 1) task value (how important it is to the visitors that they find what they were looking for) with expectations fulfilment, and 2) medium mastery (use of the Internet) with expectations fulfilment. Finally, they explored meaning-making, but the results were too vague or varied to be linked with other issues.

The review shows that one of the difficulties in building up a clear picture of the characteristics of virtual users is the wide range and ambiguous nature of category descriptions used in different studies. Still, the review confirms a link between online and in-person museum visits (Chadwick & Boverie, 1999; Kravchyna, 2004) and in general the primary purpose for using a museum web site is to support a physical visit (Booth, 1998; Kravchyna, 2004; Thomas & Carey, 2005). When trying to exclude this virtual visitor group (people looking for information to assist planning a visit) Goldman and Schaller (2004) show that virtual visitors are interested in 1) searching for content rich information and 2) exploration of museum resources. From the review it is evident that many questions remain unanswered and it shows the little attention given to elements of information seeking. For example, it is yet to be established whether basic characteristics of visitor behaviour in the physical museum, such as the explorative nature of behaviour and personal interest motivation, is reflected in a virtual museum context. We also lack finer grained information on the context of information seeking behaviour, on how information is used and how virtual visitors interact with museum resources.

3.3 Summary

In a user perspective this chapter has approached the virtual museum context and established an elaborate understanding of the empirical context of the case study. The first part of the chapter addresses knowledge organisation and indexing in the museum domain and starts by giving a historic perspective on resource description reflecting the changing role of museums. In today's reinvented museum artefacts are contextualised by human, social and cultural references potentially allowing a rich cultural complexity. Next, main characteristics of the inherently unique museum artefact are captured showing the challenges and complexity of describing heterogeneous museum collections. Also the traditional internal view on museum documentation is a challenge when aiming at providing access to digital museum resources.

The second part of the chapter discusses perspectives on museum informatics and shows how museum informatics and new technology are becoming an integrated part of the reinvented museum. First three dilemmas of digitization are presented stressing the need to reflect upon the consequences of digitization, as central issues of representation, authority, and quality are influenced and maybe altered. Secondly, two different approaches to digitization, critical versus mass digitization (Dahlström & Hansson, 2008), are taken a step further by adding a second dimension concerning the degree of virtual uniqueness, thus adapting the concepts to the museum domain. The emerging field of museum informatics is characterised, and it is showed how museum informatics is beginning to both represent and to facilitate a move towards a different understanding of the museum and its relationship with its visitors. Multiple perspectives can be applied to museum informatics when exploring the interactions between people, information and technology in museums. One such perspective is information seeking, and the growing number of digital museum resources and the call for a user oriented perspective indicate that information seeking and interactive retrieval have become relevant also within museum informatics and cultural heritage. However, a review of five selected studies of online museum visitors shows the little attention given to elements of information seeking so far. The review identifies a need to complement the previous studies, primarily based on web surveys, to extend our knowledge of e.g. the information seeking behaviour of virtual museum visitors. For example, it remains unanswered whether basic characteristics of visitor behaviour in the physical museum, such as the explorative seeking behaviour and a personal interest motivation, are reflected in a virtual museum context.

The present thesis is situated in the *intersection* between museum informatics, information seeking theory and interactive IR. It is a relatively unique combination of research areas (also partly covered by Kravchyna, 2004) reflecting that we have considerably knowledge of preservation, digitization etc. within the narrow sense of museum informatics (see section 3.2.3), whereas an enhanced understanding of how digital cultural heritage collections is used and communicated is lacking. This chapter has discussed and provided background knowledge on digital cultural heritage and the following chapter 4 will cover information seeking in a work task framework.

Finally, a remark regarding the title of the present thesis is appropriate after this chapter's discussion of the reinvented museum. The title of the present thesis is 'The reinvented museum: exploring information seeking behaviour in a digital museum context". The first part of the title is inspired by the title of G. Anderson's (2004) anthology, 'Reinventing the museum', on historical and contemporary perspectives on recent changes in the museum domain. The title of the thesis signals that the present study has been conducted within the context of a changing museum domain, where museums 1) have become repositories of knowledge (Hooper-Greenhill, 1992) and visitor-centered (G. Anderson, 2004), and 2) have become influenced by information technology resulting in the emerging field of museum informatics. Thereby the title of the thesis acknowledges that the information seeking behaviour of the individuals included in the case study are influenced by the social, organisational and cultural context surrounding and vice versa. This understanding reflects the *principle of complementary social and cognitive influence* (introduced in section 2.3.2) illustrating the dynamic, mutual influence between the individual and the social context.

4 Information seeking in work and leisure task contexts

Information seeking is a key issue in library and information science research and has been approached from various perspectives and levels of abstraction. From development of general theories or models, like, e.g., Ellis's (1989) model of information seeking features, Kuhlthau's (1991) information search process model or Dervin's (e.g., 1983) sense making approach, to studies focusing on the information needs of such disparate groups, of primarily professional users, as scholars, scientists, engineers, lawyers, or administrators (Byström, 2002; Hertzum, 1999; Zach, 2005). A common finding of many of these studies is the importance of identifying the information needs of each group in term of its own particular information environment. The literature further shows that task and discipline influence information seeking behaviour, so that any investigation of information seeking behaviour must be done in the context of the information needs of the individual users (Kuhlthau, 1991).

Based on the integrated framework the present empirical work examines information seeking behaviour of the two main user groups within work and leisure task contexts. The chapter covers four different aspects of information seeking. Together they form the theoretical background on information seeking behaviour needed for guiding the methodological set-up (chapter 5) and analysis of results (chapters 6 and 7). The first section aims at giving an outline of task-based research on information seeking and retrieval. It defines and characterises aspects of work tasks and looks at theoretical models and empirical findings. Especially the first section can be seen as a direct continuation of chapter two on the cognitive viewpoint as it explicitly builds on the formation and understanding of the information need and the concept of context. The second section focuses information seeking in everyday life context. The ELIS framework is presented together with the concept of serious leisure. The third section covers information seeking behaviour of historians and professionals within cultural heritage. The fourth section discusses exploratory searching behaviour. It relates to the hypothesis on exploratory searching behaviour of virtual visitors. Together, the four sections provide the thesis a theoretical frame regarding information seeking. Finally the fifth section summarises the chapter.

4.1 Task-based information seeking

In recent years the concept of work task has received growing attention in information seeking contexts (Bystrom & Hansen, 2005; e.g., Byström & Järvelin, 1995; Dervin, 1992; Hertzum & Pejtersen, 2000; Marchionini, 1995; Vakkari & Hakala, 2000) as well as in information retrieval contexts (e.g., Belkin et al., 1982; Borlund, 2000b; Ingwersen, 1996; Park, 1993; Vakkari, 2001b). In the integrated framework for information seeking and retrieval the concept of work task is a central contextual dimension (see chapter 2), and following Järvelin (1986), work tasks are seen as the driving force underlying IS&R. The concept of task is important in relation to gaining an understanding of why people seek information, the type of information they seek, the methods they choose to acquire it, and how they use it (R. S. Taylor, 1991). The task-based approach to IS&R can be seen to give ground to combine two core research areas within information studies: information retrieval and information seeking.

4.1.1 Definition and types of work tasks

Several approaches have been suggested to define and characterise "work task" in IS&R literature. Vakkari's (2003) critical review of task-based information searching provides an overview of a rather fragmented research area and shows the complexity of the work task concept. Based on Vakkari's review, Byström and Hansen (2005) point to the lack of holistic definitional analyses in the research field. Despite this, some general characteristics can be found which will be described in the following.

A work task can be defined as an *activity* a person has to perform in order to accomplish a goal (Hansen, 1999; Vakkari, 2003). A work task has a recognizable beginning and end, and may consist of a series of sub-tasks, resulting in a meaningful product (Byström & Järvelin, 1995; Vakkari, 2003). Sub-tasks can be various kinds of tasks including tasks related to IS&R. An information related task is called a *search task* and is a sequence of activities with the goal of finding specified information (Ingwersen & Järvelin, 2005, p. 73; Vakkari, 2003). Search tasks include *retrieval* and *seeking tasks*. Where retrieval tasks include the use of an information retrieval system and seeking tasks furthermore involve people as information sources. Retrieval tasks are embedded within seeking tasks in line with the nested model of IS&R (see Figure 2.1). The above definition of work task is independent of the type of setting. Thus, even though work tasks are typically defined in a professional setting as, e.g. Byström and Hansen (2005), this thesis adapts Ingwersen and Järvelin's (2005, p. 282-283) broader conceptualization of work task in order to include leisure tasks or interests of virtual museum visitors (the majority are non-professionals).

Work tasks can be characterized according to their degree of authenticity in the research settings. A distinction can be made between *natural* work tasks, *simulated* work task situations, and *assigned* requests for information (Ingwersen & Järvelin, 2005, p. 283; Vakkari, 2003, p. 421). *Natural* work tasks are carried out in real-life and user's information needs are reflected in the task performance process. They may exist objectively as tasks within an organisation. When a work task is assigned to employees as part of their job, the employees perceive the work task according to their own context. The perceived work task is thus of subjective nature. *Assigned* requests are search topics meant to represent information needs. They are primarily used in IR experiments and are not applied in the present study. S*imulated* work task situations, as proposed by Borlund (2000b), are a modification of artificial, assigned request, which attempt to provide the user with a more robust description of the information problem. They are designed to IS&R research setting by introducing cover stories of semantic open simulating natural tasks. The aim is twofold. Firstly, to promote a simulated information need in a subject. That is, permit individual interpretation of the situation. Secondly, to provide experimental control within a realistic context, as all test persons receive the same simulated task. The research method in the present study includes analyses of both natural work tasks and simulated work tasks (see chapter 5).

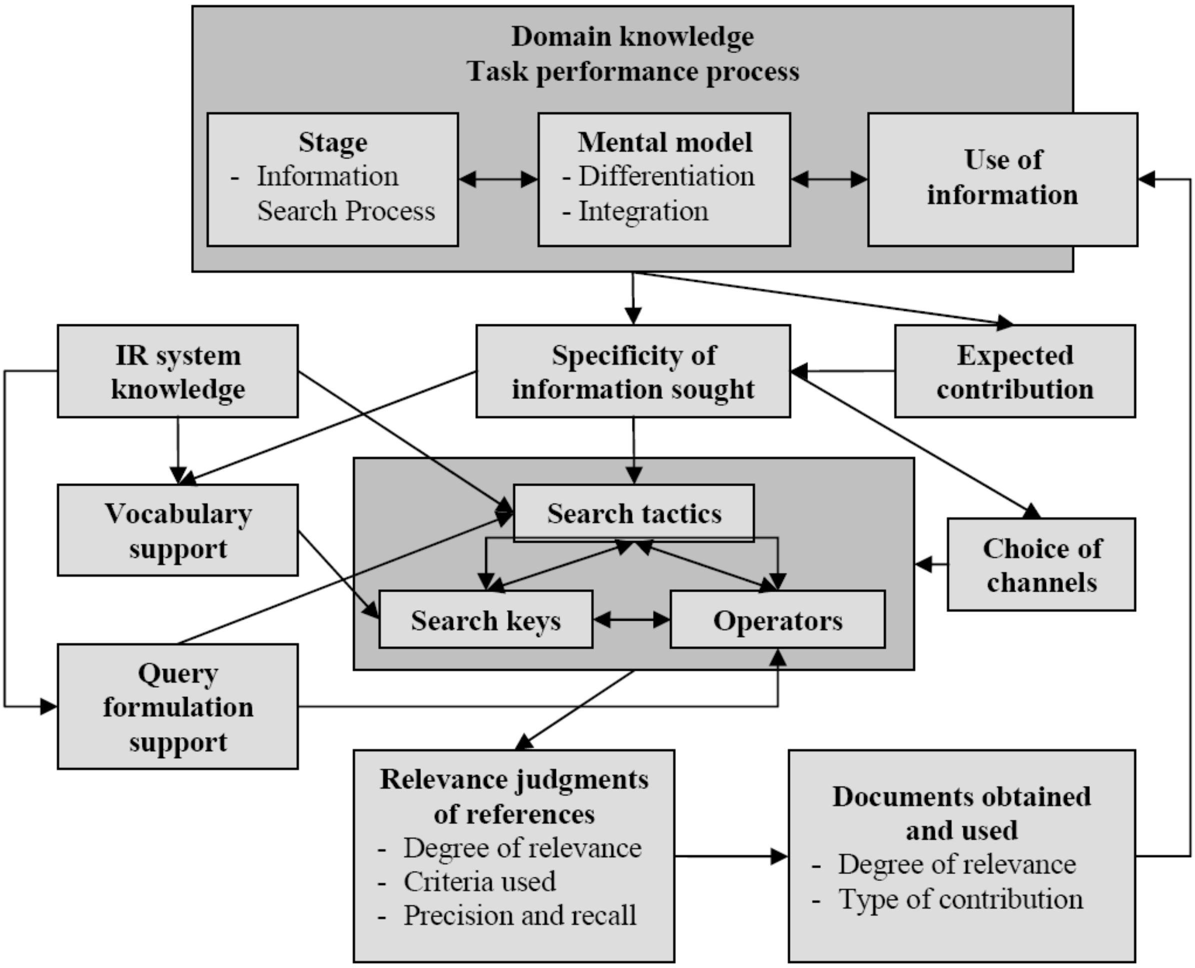
In the present case study, work tasks serve as a common starting point to scrutinize individual actor's information seeking behaviour during task performance. The concept of work task is used to offer an empirical unit for analysis. This perspective corresponds with the integrated framework presented by Ingwersen and Järvelin. However, the elements of the generalised framework (see Figure 2.4) represent IS&R processes on an abstract and general level. In order to provide a more detailed understanding of the seeking process, the next section introduces Vakkari's task-based information seeking model.

4.1.2 Towards a theoretical model of task-based information seeking

Several theoretical information models have applied focus on work tasks. Some important examples of such models are the iterative process model by Marchionini (1995) identifying eight tasks within the information-seeking process, Kuhlthau's (1991) model of the information search process explains how emotional properties are related to different phases of information seeking tasks, and Byström's (2002) illustration of how perceived task complexity modifies needs for different types of information as well as choice of information sources. More recently, Kelly (2006a; 2006b) has identified theoretical implications for determining how documents are related to specific tasks. The examples illustrate the different foci emphasised in task-oriented research.

The focus in Vakkari's work on task-based information searching is to explain patterns between stages in task performance, search tactics, and usefulness of the information retrieved (Vakkari, 1999; Vakkari, 2001a; Vakkari, 2001b). Based on a series of longitudinal studies and an extension of Kuhlthau's (1991) model of the information search process, Vakkari (2001a) proposes a model of the information search process in task performance. The model is shown in Figure 4.1. It integrates Kuhlthau's searching stages as a part of task performance and expands it into IR. Further, the model predicts that the stages of task performance and the searcher's mental model have a "…systematic impact on the information types sought, on the choice of search terms and tactics as well as on the assessment of relevance and contribution of the relevance of references found and full-tests acquired in the task performance process" (Vakkari, 2001a, p. 306).

Ingwersen and Järvelin (2005, p. 199) point to three strengths of Vakkari's model. Firstly, the clear-cut distinction between domain knowledge as associated to work task performance, and IS&R knowledge. This distinction between knowledge types allows us to explore which features of seeker's knowledge and goals generate which types of information needs. The same distinction is applied by Ingwersen and Järvelin in their matrix of eight intrinsic types of information (see section 4.4). Secondly, the work task stages and use of information in work task solving are separated from search task execution. Thirdly, the concept of 'expected contribution', which refers to the experience gained by the actor in a historical sense, is also an asset of the model. In addition, in relation to the present study it is an important aspect of the model that it explicitly expresses relations between components of the search task (search tactics, search keys and operators) with the other components.



Legend: Boxes represents concepts. Arrows represent the direction of impact.

Figure 4.1: Vakkari's model of the information search process in task performance (Vakkari, 2001a, p. 308).

Vakkari's model is empirically based and later verified in investigations of university students (Serola & Vakkari, 2005; Vakkari, 1999; Vakkari & Hakala, 2000; 2001a; Vakkari, 2001b). Some of the empirical findings are commented in the next section. Based on these empirical findings, Vakkari makes a strong case for work and search tasks as essential factors for understanding and explaining IS&R. Accordingly, knowledge of the searchers perception of work tasks enables us to obtain research results, which can also provide useful information for information system design.

4.1.3 Empirical findings of connections between work task and searching

A range of empirical studies examine the effect of work tasks on various IS&R activities. Directed by the research questions this section will focus on two aspects: 1) the relation between task and the use of sources and channels, and 2) the relation between task and searching in information systems. The second aspect is especially concerned with how work tasks are related to preferred access points (directed by research question 2.b).

Several studies of the relation between task and the use of sources and channels show that actors' information-seeking patterns vary in relation to the stage of their work task. This is, e.g., shown in a study of engineers and research scientists by Ellis and Haugan (1997). Their findings show that information seeking is most extensive in the initial phase of the project, and when researchers become more knowledgeable, focused and specific about the problem, they are increasingly selective. In the initial stage both formal and informal channels are utilised but the use of formal channels decreases as they progress in the project. Instead personal communication seems to be a more dominant factor (Ellis & Haugan, 1997, p. 400). Similar patterns are identified among literary critics (Chu, 1999) and industrial researchers (Hirsh, 1999).

While the aforementioned studies examine how research stage affects type of information needed and use of sources and channels, Byström and Järvelin (1995) take a different approach. They developed a causal model to explain how *task complexity* affects information seeking and use. Derived from empirical investigations in a work setting, they divide task complexity according to a priori determinability of task input, process, and outcome. The following five categories of increasing complexity are found: 1) *automatic information processing* tasks are routine tasks completely a priori determinable and could in principle be automated; 2) *normal information processing tasks* are almost completely a priori determinable with elements of case-based arbitration; 3) *normal decision tasks* are quite structured, including primarily case-based arbitration; 4) *known genuine tasks* are based on a priori known type and structure of result, but task procedures are unknown, and 5) *genuine decision tasks* are unexpected, new and unstructured, and accordingly results or information requirements are not a priori determinable (Byström & Järvelin, 1995, pp. 194-195). The qualitative results show that work task complexity indeed affected certain variables in information seeking (Byström & Järvelin, 1995, p. 211). More specifically, an increase in task complexity brought an increase in the complexity of the information needed, an increased need for domain and problem-solving information, and an increase in the number of sources used. At the same time, the use of problem and fact-oriented sources decreased, and so did the use of internal channels and success of information seeking. As the examined unit was employees' *perceived* work task, a task considered a normal decision task to an expert, might be perceived as a genuine decision task to a novice. A similar point is put forward by De Mey (1984).

Byström and Järvelin's (1995) model is valuable because it explicitly show a dependency between one central task characteristic, task complexity, and information seeking. However, other task features, like perceived task strategies and practices or dependencies with other tasks, remain yet to be studied (as indicated by Ingwersen and Järvelin's (2005) multidimensional research design cube). Byström and Järvelin's study together with the other studies of task mentioned above show that actor's use of information channels and sources is related to work task.

The second aspect of work task covered in this section, the relation between work tasks and searching in systems, has likewise been approached in a variety of studies. For example by addressing the relation between task and the relevance assessments process (e.g., Cosijn, 2006; Wang, 1997), between task and use of search tactics and operators (e.g., Vakkari, 2000a; Wildemuth, Jacob, Fullington, de Blieck, & Friedman, 1991) or between task and relevance feedback (Ruthven, Lalmas, & Rijsbergen, 2003). However, literature on the relation between work task and the aspect of searching in information systems relating to preferred access points is limited. One way to approach the aspect is to address studies of users' choice of search terms. Three longitudinal studies of task in a research process examine choice of search terms (Vakkari, 2000a; Vakkari, Pennanen, & Serola, 2003; Wang, 1997). From the three studies we learn that in the beginning of a research process the topic is represented with few terms. As the research process proceeds the vocabulary grow substantially larger and more specific. According to Vakkari (2000a) this process can be explained by how participants seem to have a vague mental model of the task in the initial stages of the research process. This mental model becomes more focused as they become familiar with the requirements of the task, and toward the end of the process participants seem to employ more focused and specific information. The three studies provide valuable information, but as the research design of the present study is not longitudinal, the results are not easily comparable.

The above presented theoretical models and empirical results of work task based information seeking have not yet resulted in information retrieval systems that incorporate these models and findings. However, the research represents strong evidence to suggest that there is value in taking a task-based approach to IS&R. To the present author's knowledge, the concept of work task has not been applied to everyday life situations. Byström and Hansen (2005) offer the explanation that, this is due to everyday life situations *not* being as expressly goal-oriented in their resolution as job-related work tasks. In addition, it can be explained by how ELIS studies traditionally focus on broader social aspects of information seeking and use (see section 4.2). The present study, as suggested in the integrative framework, applies a broad definition of work task also to include leisure task. Accordingly, the present study examines characteristics of information seeking from a work task perspective in order to connect the work/leisure task (and derived information seeking task) with the search process and analyse how they interact.

4.2 Information seeking in everyday life context

Studies of information seeking behaviour have mainly focused on information intensive work related environments and scientific users and students in particular (Butterworth & Perkins, 2006; Hartel, 2003; McKenzie, 2003; Savolainen, 1995). Also Ingwersen mentions the focus on the professional environment: "…there exists an inherent and silent agreement that information behaviour, seeking and retrieval mainly take place among academics" (1996, p. 13). Savolainen (1995) argues that the questions of non-work information seeking deserve equal attention and should not be overshadowed by surveys of job-related information needs, seeking and use. Hence, as a contribution to the area of non-work information seeking, Savolainen introduces the concept of ELIS[24] defined as "…the acquisition of various informational (both cognitive and expressive) elements which employ to orient themselves in daily life or to solve problems not directly connected with the performance of occupational tasks" (Savolainen, 1995, p. 267).

Since Savolainen introduced the ELIS framework, many studies have taken ELIS as their focus. Research has been carried out focusing on social groups like, e.g., information-seeking behaviour of older adults (Williamson, 1998), or of urban young adults (Agosto & Hughes-Hassell, 2005), or focusing on distinct areas like health information (Johnson, Andrews, & Allard, 2001), or leisure information (see section 4.2.2). The area of leisure information seeking is particularly relevant as the virtual museum visitors in the present study can be categorised as belonging to this group. Accordingly, section 4.2.2 discusses related ELIS research situated in a leisure or hobby context. First, however, the following section outlines the ELIS framework.

4.2.1 Savolainen's ELIS framework

The ELIS framework was developed by Savolainen in the mid 1990s motivated by a need to elaborate the role of social and cultural factors that affect people's way of preferring and using information sources in everyday settings (Savolainen, 1995, p. 143). It is a framework for social and psychological factors affecting people's source preferences in everyday life. Savolainen suggests that ELIS habits and attitudes allow people to use their personal values and beliefs to make meaningful life choices. See the ELIS model in Figure 4.2.

He introduces the concepts of "way of life" and "mastery of life" for understanding the role of information-seeking in individuals' everyday problem-solving activity. A person's "way of life" refers to a person's everyday activities and the value the individual assigns to each of these activities. Based on these values, people decide the order that these activities will be addressed in terms of information gathering. The concept of "way of life" refers to "order of things", which is based on the choices that individuals make in everyday life (Savolainen, 1995, p. 262). "Way of life" reflects the individual's major interests like, for example, hobbies. Thus, one way of operationalising "way of life" is to look at the nature of hobbies, as an analysis of hobbies can inform us of things people find most pleasant and the analysis can also point to information interests in leisure time. The concept of "way of life" is complemented by the concept of "mastery of life" as the making sure that people actually adhere to their own preferences when taking on everyday activities: "Because the meaningful order of things might not reproduce itself automatically, individuals are required to take active care of it. *Mastery of life* is this caring activity. […] Mastery of

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[24] Although Savolainen (1995) coins the term ELIS, the large-scale studies of non-work information seeking dates back to the 1970s (e.g., Dervin et al., 1976; Warner, Murray, & Palmour, 1973).

life is a general preparedness to approach everyday problems in certain ways in accordance with one's values (Savolainen, 1995, p. 264). Savolainen further explains that information-seeking habits are usually developed as part of the mastery of life.

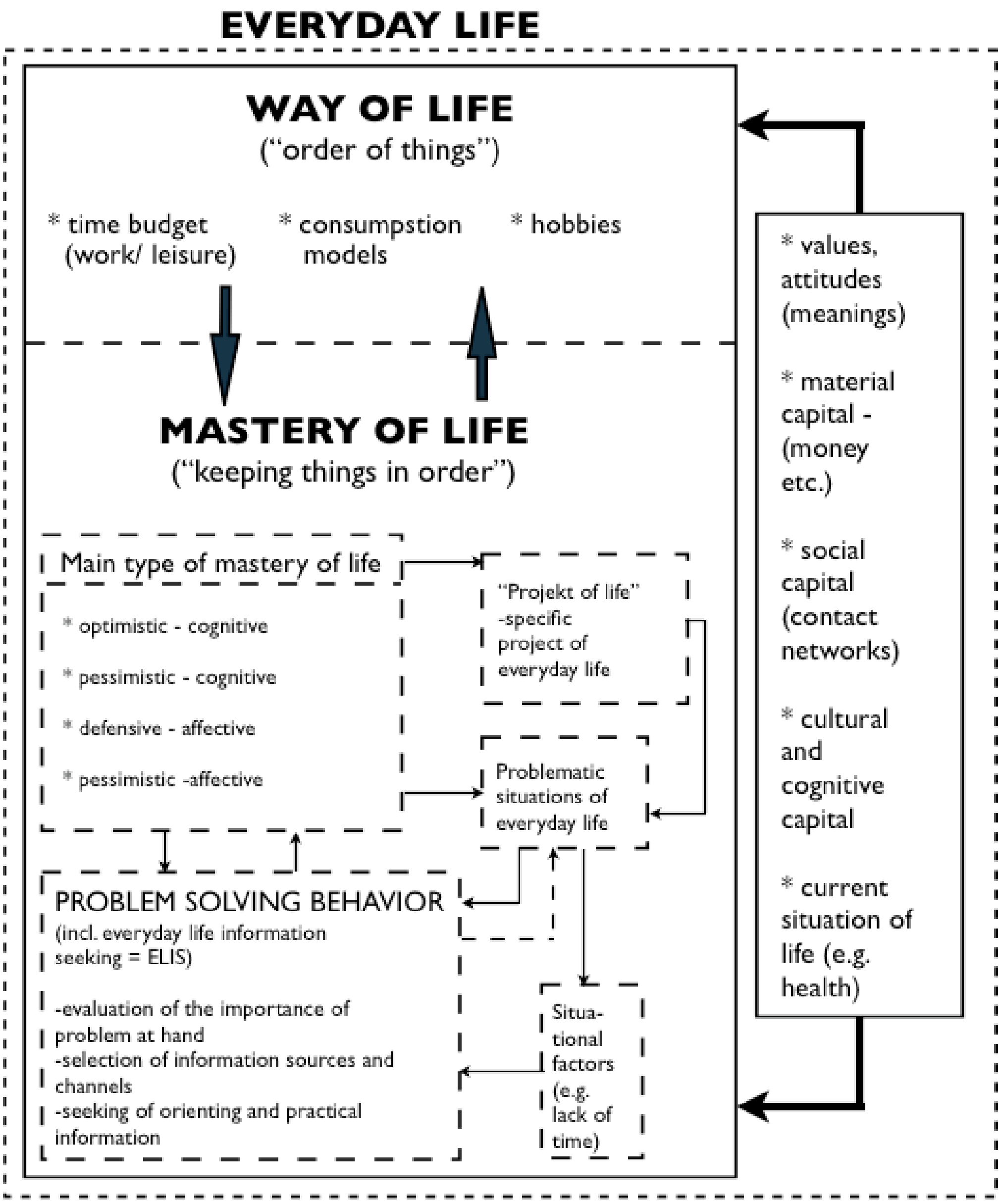

Figure 4.2: Savolainen's ELIS framework (Savolainen, 1995, p. 268)**.**

In relation to the present study, Savolainen's ELIS framework, concerning the role of "way of life" in information seeking, provides a useful framework for thinking about military history hobbyists' choices as a component of leisure and everyday practices. The concept of "way of life" can be seen as a proxy for context. Accordingly, the ELIS model (Figure 4.2) contributes with contextual factors (such as personal values and social capital) that are important to include in a non-work context. In the present study, the ELIS model is thus seen as complementary to the integrative viewpoint adding further layers and identifying contextual factors relevant to consider to gain an understanding and characteristic of the (small part) of everyday practices analysed in the case study. The knowledge needed to design better systems and services is likely to include an understanding of these everyday practices.

4.2.2 ELIS in the context of hobby activities

The concept of *serious leisure* is introduced here in order to address the virtual museum visitors' leisure activities of everyday life. The concept of *serious leisure* was coined in 1982 by sociologist Robert Stebbins[25] and can be defined as the, "systematic pursuit of an amateur, hobbyist, or volunteer core activity that people find so substantial, interesting, and fulfilling that, in the typical case, they launch themselves on a (leisure) career centred on acquiring and expressing a combination of its special skills, knowledge, and experience (Stebbins, 2007, p. 5). It is an interdisciplinary concept which Hartel (2003; 2006) introduces within LIS research. She advocates for the importance of serious leisure for research in information seeking behaviour as serious leisure activities are a personally cherished and socially important part of everyday life *and* highly informational involving knowledge acquisition (Hartel, 2003; Hartel, 2005). According to Hartel, Stebbins' work on serious leisure supplies "…definitions, descriptions, and classes that make leisure a more approachable research topic" (2005, p. 313), and thus assists to explain key elements of leisure so it can be prioritised and approached systematically.

According to Stebbins (e.g., 2007) there are three general forms of serious leisure: amateurism, volunteering, and hobbies (see Figure 4.3 for an overview of leisure forms). The group of virtual museum visitors, participating in the present study, can best be described as hobbyists (see also section 7.1.1), and therefore focus is on

[25] Robert Stebbins has published numerous items on the serious leisure concept. In 2007 he published the book "Serious leisure" (Stebbins, 2007) to gather the literature on leisure into a coherent resource. At this occasion he modifies and sharpens some of the definitions, and it is these definitions which are used in this chapter.

hobbies. A hobby is the systematic and enduring pursuit of a reasonably evolved and specialised free-time activity (Stebbins, 2003). Hobby is done for pleasure, without external rewards. Hobby is the most popular of the three forms of serious leisure and there are five hobby classes: collectors, makers and tinkers, activity participants, players of sports and games, liberal arts enthusiasts (e.g., Stebbins, 2007). Examples of the hobby classes are given in Figure 4.3. The figure is based on the labelling and definitions from Stebbins (2007). The model is an extension of Hartel’s (2003, p. 232) summary model, in that a “project-based leisure” category is added (based on Stebbins, 2007) and also examples of hobby types are added. Examples of hobby types indicated in bold relates to the present case study. The hobby classes are self-explanatory except from the liberal arts enthusiast, who performs “…the systematic and fervent pursuit during free time of knowledge for its own sake” (Stebbins, 1994, p. 174). This definition indicates that the process of developing expertise is important and enjoyed by the liberal arts enthusiasts, however, they do not necessarily further implement their knowledge. Study of information seeking is especially of interest in relation to the hobby class of liberal arts enthusiasts given their emphasis on knowledge acquisition (Hartel, 2003, p. 236).

The majority of participants in the present case study of virtual museum visitors are categorised as collectors (of objects like photographs, weapons, military uniforms etc.). However, participants in the case study include representatives from all five hobby classes (see examples of these hobbies written in bold in Figure 4.3 and see section 7.1). Previous studies of information seeking in relation to hobbies have mainly focused on a single hobby class and a central activity like pleasure reading (Ross, 1999), cooking (Hartel, 2003; 2006) or genealogy (Yakel, 2004). The present case study differs from these studies as the starting point is a specific online system (The Military Museum’s online catalogue) which explains the more varied user group.

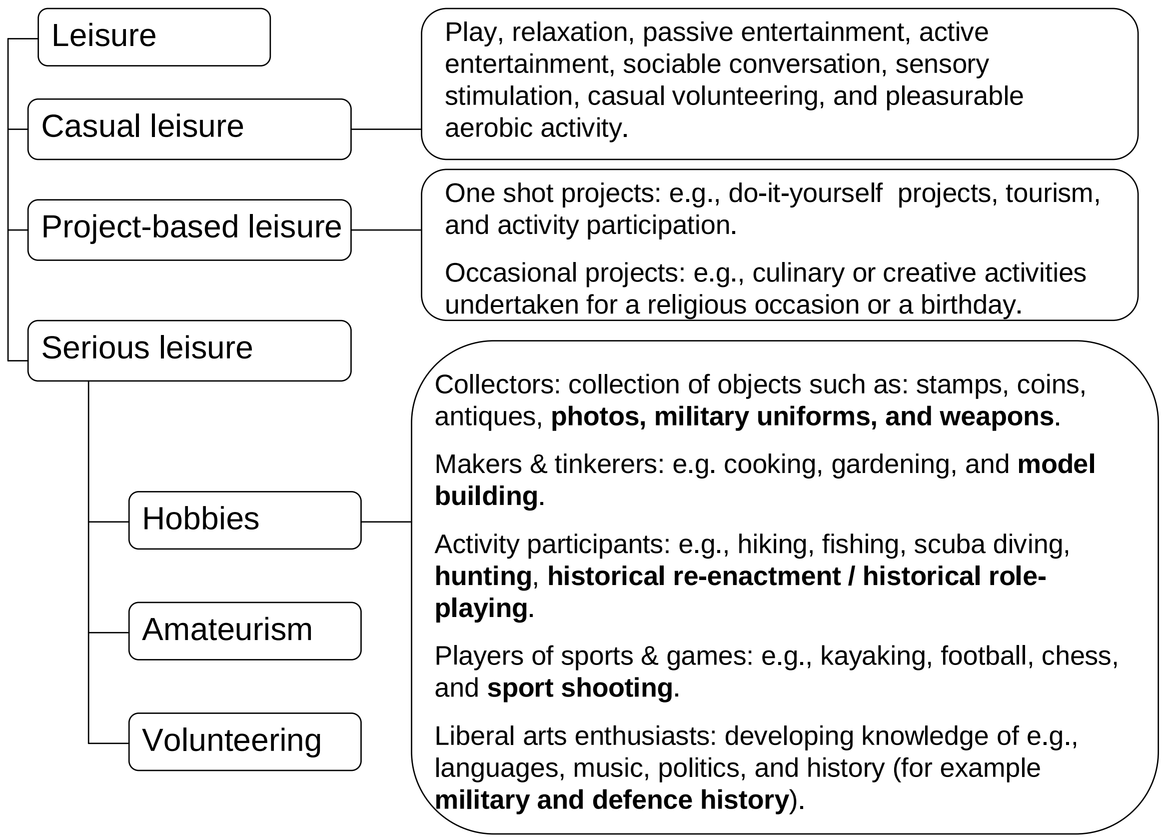

Figure 4.3: A model of the serious leisure concept

In the same way as the above definitions and categorisations of serious leisure and hobby assist us in gaining a structured approach to the serious leisure realms of everyday life, the following six characteristics defining serious leisure help us to describe the (information seeking) behaviour of hobbyists:

1. A need to persevere
2. Leisure career that proceeds in stages: beginning, development, establishment, maintenance, and decline
3. Proactive knowledge, experience and skill acquisition
4. Durable benefits of personal and social rewards
5. Unique ethos or culture
6. Strong identification with the chosen pursuit (Stebbins, 2007, pp. 11-13).

The six characteristics of hobbyists identified by Stebbins can help explain what motivates the work tasks of the military history hobbyists and in this way add to a characteristic of their information seeking behaviour.

Within everyday life information seeking research, a handful of case studies of leisure exist. These studies are reviewed in the following with focus on aspects of information seeking where leisure differs from other contexts. First, Hartel's (2003; 2006) study of *gourmet cooking* hobbyist is based on both Savolainen's ELIS framework and Stebbins's serious leisure concept. She uses the population of gourmet cooking hobbyists as an example of the potential for the studies of serious leisure within information seeking. In the study, series of concentrated episodes of information seeking is identified relating to the central activity of cooking. Similar to Hartel, Ross (1999) focuses on a specific hobby when addressing information encounter during *pleasure reading*. An interesting finding in Ross's study is the explanation of how readers encounter information without any expressed need for it. Rather, it is a non-goal oriented information encountering (1999, p. 796) similar to serendipity (see section 4.4.2).

The two studies by Yakel (2004) and Duff and Johnson (2003) are particularly interesting because they provide the only research studies specifically on information seeking by genealogists/family historians[26]. These studies within archives can be seen as closely related to museums because of the many points of resemblance between the two types of cultural heritage institutions. Yakel's (2004) study of genealogy and family history is conducted within an everyday life information seeking framework and explores the motivation and use of sources. Yakel describes family history as an activity without a clear end goal. Instead genealogy should be viewed as an "…ongoing process of seeking meaning. The ultimate need is not a fact or date, but to create a larger narrative, connect with other in the past and in the present, and to find coherence in one's life" (Yakel, 2004). Yakel concludes that being a family historian includes seeking facts as well as seeking meaning and self-identification. The latter aspects (seeking meaning and self-identification) distinguish information seeking in genealogy from professional settings. Duff and Johnson (2003) study information seeking patterns in archives and libraries, search strategies and interaction with access systems. They found that genealogists were as likely to work around existing systems as to use them

[26] For a discussion of the distinctions between genealogists and family historians see Yakel (2004).

and that, in the search process, genealogists relied more heavily on their own social networks than on information from professionals.

Together the above studies of information seeking in leisure context indicate that information behaviour during leisure, at least in some respects, differ from scholarly and professional contexts. This stresses the importance of studying information seeking in a context sensitive approach.

4.3 Information seeking behaviour of historians and professionals within cultural heritage

This section will focus on the second group of participants in the present case study, the museum professionals. Likewise, characteristics of the virtual museum visitor have been addressed earlier (see section 3.2.5). Research on experts' information needs and use of information sources and channels in the cultural heritage domain is very limited. Therefore the first subsection takes a somewhat broader perspective and describes scholarly historians' information seeking behaviour. This makes sense as 8 of the 10 curators, in the present case study, are historians and because research activities are one of the curators' main work tasks (see also section 6.1.1). The characteristics of scholarly historians' information seeking behaviour provide insight and a context within which to understand experts' behaviour in a cultural heritage context. Accordingly, the second subsection discusses the very limited number of studies related to information seeking behaviour of professionals in a cultural heritage context.

4.3.1 Historians' information seeking behaviour

The research field of history is a humanistic discipline. To illustrate historians' information seeking behaviour we turn to studies specifically addressing the research field of history as well as investigations within the arts and humanities as a meta-discipline. Bates describes how attention has turned to the research fields of arts and humanities in the 1980s and 1990s, whereas earlier decades have focused on needs of scientists, engineers and social scientists (Bates, 1996c, p. 155). A good example of this is Case (1991), who specifically focuses on the nature of research in history and the process of historical inquiry. Case's qualitative study is interesting because it relates historians' use of specific information sources and channels to motivations for, and results of, such use. Hence, he elicits from historians' description of their work tasks to add to our understanding of their use of information. Case observes that stages in historical research are illusory and different research activities can go on concurrently, both within and across individual projects. However, he identifies the following four activities within scholarly historians' research process (Case, 1991, pp. 78-79):

- Choosing and refining topics
- Planning and conducting studies
- Gathering and interpreting evidence
- Writing and revising manuscripts

The four types of research activities are comparable to the five stages of Stone's more general model of work tasks in the humanities (Stone, 1980, p. 16) and Chu's identification of six stages of the literary critic's work (Chu, 1999, p. 259). Like Case, Chu emphasises that the stages do not occur in a pre-determined linear sequence. Case does not explicitly identify how different research activities relate to different information sources and channels. Yet, he stresses how reliance upon original evidence is especially important to historians and the use of primary sources (manuscripts, newspapers, books, letters, photographs, portraits, objects, drawings etc.) as the heart of what they do (Case, 1991, pp. 73-74). Based on his findings Case describes historians in the following way:

> "Historians, then, are people who read, condense, collect, assimilate, transform, and synthesize written records of past times. They scan the environment for stimuli that match certain characteristics – a landscape that consists of texts: books, periodicals, and original source documents (such as letters, diaries, and archival material) – supplemented by non-textual materials, such as pictures, photographs, and films" (Case, 1991, p. 63).

Further, Case also points to the common finding that humanist scholars' use of technology is low. This finding is also addressed by several other researchers (e.g., Bates, 1996b; Watson-Boone, 1994; Wiberley & Jones, 2000). Based on a ten-year longitudinal study of a group of humanist scholars' use of information technology, Wiberley and Jones (2000) argue that the low use of technology is *not* caused by technophobia but by the limited value of technology to advance in humanistic scholarship. They identify *time* as an important explanatory factor, and describe how fear of lost productivity through time spent learning and using electronic technologies were among the primary barriers to use of information technologies. According to

Wiberley and Jones, humanist scholars will gradually become more involved with information technology. A key motivation for this involvement is, because of humanist scholars' focus on primary data sources, the use of information technology to access primary sources (Barrett, 2005; Wiberley & Jones, 2000, p. 428). In Talja and Maula's (2003) study of four scholarly disciplines' use of electronic journals and databases, historians' low use of electronic resources is supported. The study shows how historians' low use (or non-use) of electronic journals and databases is due to lack of sufficiently retrospective materials, and to difficulties in obtaining the relevant items identified in searches (Talja & Maula, 2003, p. 681). Further, they relate differences in search strategies to scholarly discipline. This relation is also examined by other researchers and three interrelated characteristics of searching behaviour, in relation to humanist scholars, are addressed in the following.

Firstly, humanities scholars are noted for their preference for *informal channels* to information over more systematic searchers (e.g., Duff & Johnson, 2002; Green, 2000; Talja & Maula, 2003). The second aspect relates to *prior familiarity* to documents identified by searching. Bates (1996a) describes how knowledgeable humanities scholars must have read closely and be intimately familiar with a large number of particular works. Thus, she suggests that *prior familiarity* may prove to be a much larger factor in information retrieval in the humanities than in the sciences (Bates, 1996a, p. 699). Bates find that a humanities scholar expects to be familiar with the majority of the retrieved results, and for instance, a 200-item search is considered to be of great success if it produces one or two novel references (Bates, 1996a, p. 700). Thirdly, as a consequence of the humanities scholars' prior familiarity with most items, they use *browsing and chaining* as their primary search strategies. This is for example verified by Talja and Maula (2003) in a study specifically addressing historians[27]. Likewise, Watson-Boone (1994), in her literature review of humanities scholars, points to browsing as an important search strategy mainly because of the element of serendipity in browsing. Chaining, that is, gathering of references from seed documents and from informal sources like everyday colleagues or interaction at conferences is equally an important search strategy (Bates, 1994; Talja & Maula, 2003).

[27] Talja and Maula's study (2003) of search strategies and use of electronic journals and databases includes empirical data from four different disciplines. However, only findings regarding historians are included here.

Adding up, the searching behaviour of historians may best be described by how they gather information from a variety of sources, a bit at a time, here and there. This pattern of searching is identified and named "berrypicking" mode by Bates (1989). It will be further discussed in section 4.4 on explorative searching behaviour.

As briefly mentioned above, reliance upon *original evidence*, primary sources, is important to historians, and for historians the original material is primarily to be found in the archives (Case, 1991). Primary sources are also found in the museums, and close parallels exist between the two types of cultural heritage institutions. Obviously, primary sources are equally important to cultural heritage experts like curators at museums.

A handful of studies (e.g., Beattie, 1989; Cole, 1998; Duff & Johnson, 2002; 2003; Tibbo, 1993; 2002; Toms & Duff, 2002) have examined historians' use of archives and archival finding aids within the research process. To a large extent these studies of historians' use of archives confirm the findings from studies of historians' information seeking behaviour in general (see above). For instance regarding preference for informal channels and browsing as an important search strategy. In addition, the studies bring our attention to two characteristics specifically relating to archives and access to primary sources. Firstly, the more recent of these studies point to the importance of providing online access to digitized collections themselves (primary sources) in addition to providing access to descriptions of these materials. It eases the historian scholar's access and saves him time and travel expenses (Duff & Johnson, 2002; Tibbo, 2002). Secondly, because provenance[28] is the guiding principle for the organisation of archival materials, *name* is the most common access point followed by date, place, event, and subject. Due to the constraints of organisation by provenance, topic-oriented research can be problematic because of lacking subject access into collections (Duff & Johnson, 2002; 2003). A parallel can be drawn to how description of museum objects often focuses on the "thingness of the thing" including the physical properties and object classification (Rinehart, 2003) (see also section 3.1.2).

[28] Provenance is the guiding principle of the organisation of archival materials. Records are organised according to the body that created them and are the record of the activities of that body (Bearman & Lytle, 1985). Bearman, D.A. & Lytle, R.H. The power of the principle of provenance. Archivaria 21, Winter 1985-86): 14-27.

This section has discussed the information seeking behaviour of humanities scholars and in particular historians. The studies included have mainly focused on understanding conceptually what historians do when they conduct research and characteristic of their searching behaviour. Before moving on to section 4.4 on explorative searching behaviour, the following section addresses professionals in cultural heritage institutions.

4.3.2 Information seeking behaviour of professionals in cultural heritage

Research on experts' information needs in the cultural heritage domain has not been thoroughly investigated and only a limited number of studies address this area. In a museum context, a notable exception is a user study of cultural heritage experts' search for information by Amin, Hardman and Ossenbruggen (2007). Based on use cases and interviews they identify four main work tasks of cultural heritage experts (object handling, planning exhibition or publication, managing the collections' documentation, and building thesauri) and main information sources used. They group search related issues encountered by the experts into the following five groups (Amin et al., 2007):

- Integration: relates to how cultural heritage experts deal with many systems and sources as well as very heterogeneous data.
- Query semantics: relates to query issues which require some degree of semantics to help get better results. E.g., 1) many languages, alphabets, spellings; 2) time and location are often used as query constraints; and 3) search for relationships or similarities.
- Query formulation: relates to issues which require interface solutions in addition to technologies such as image analysis or semantics.
- Credibility: relates to the trustworthiness and perceived quality of information retrieved.
- Annotation: relates mainly to the often incomplete or too narrow annotations.

The issues identified in the study are highly relevant in relation to the present case study, and several of the issues are recognised and further validated (see chapter 6). Findings of the study were used to inform system and interface design, but not related to inform or discuss the construction of annotations (object description).

Besides the study of Amin, et al., also Marty (2000; 2007) looks at cultural heritage experts but he takes another perspective and reports on the socio-technological impact of introducing new tools and technologies into museum professional work tasks. These studies are, however, not considered relevant in the present study.

4.4 Exploratory searching behaviour

In recent years there has been a shift towards design of information systems to support the larger task rather than only to provide information that matches the user's keywords. A more user-centered approach in both design and evaluation of interaction between searcher and system is part of this shift (e.g., Borlund & Ingwersen, 1997; R. W. White, Muresan, & Marchionini, 2006) (see also section 2.3 on the integrated framework). At the same time an increasing research interest takes place within the area of *exploratory search* that blends querying and browsing strategies (Marchionini, 2006; Qu & Furnas, 2008; R. W. White, Kules, Drucker, & Schraefel, 2006).

This section will address theoretical elements of users' exploratory searching behaviour. As earlier sections indicate, artefact related search tasks in a museum context are expected to include exploratory behaviour. More precisely, the section is motivated by the hypothesis about virtual museum visitors' exploratory behaviour (see section 1.3), which is supported by studies of visitor behaviour in the physical museum (see section 3.2.5). Likewise, studies of historian scholars' berrypicking behaviour can be related to the professional museum curator (see section 4.3.1).

The section has three subsections. First we look at the relation between information needs and searching behaviour and thus the distinction between well-defined and muddled or explorative information needs. Secondly, two exploratory approaches to information seeking are discussed. Thirdly, as exploratory searching often includes some form of browsing, the third sub-section presents approaches to browsing strategies and motives for browsing.

4.4.1 Information needs and searching behaviour

As a point of departure for discussing the relation between type of work task, information need and corresponding searching behaviour, Ingwersen and Järvelin's matrix[29] (Table 4.1) of four distinct cases of human intrinsic information requirements is applied. The matrix is constructed along two dimensions: the *quality* and *variability*

[29] The matrix is an altered version of Ingwersen (1996, p. 15; 2001, p. 164).

of the information need. The first dimension relates the quality of current knowledge, as defined in the mind of the actor. The second dimension relates to the variability of the need over time, i.e., the actor's motivation and ability for change (Ingwersen & Järvelin, 2005, p. 297). Given a perceived work task type and type of information need, the matrix illustrates the corresponding search (task) behaviour. In this way, the matrix identifies and connects different types of information needs to different information seeking activities within the search process. Thus, the matrix shows a fourth dimension of the information needs typology introduced earlier. The transition between the four cases is continuous.

Table 4.1: Intrinsic information need types. Source: Ingwersen and Järvelin (2005, p. 291)

Intrinsic information need variability – given a perceived work task type	**Well-defined** (Work task: Routine or Normal	**Ill-defined**
Stable	Known Item Known Data Element Known Contents – Factual *Querying* *Filtering behaviour*	Genuine work task Muddled: Item – Data – Element – Contents – Factual *Search loops*
Variable	Known Contents – Factual *Querying – Navigation* *Dynamic interaction*	Genuine/normal work task Muddled: Item – Data – Element – Contents – Factual *Browsing* *Trial & Error behaviour*

So far, most of traditional IR research has been concentrated on the upper left corner. Consequently, support for IR is based on the assumption that users have stable and well-defined information needs. The following section covers two examples of exploratory searching behaviour: berrypicking and information encountering.

4.4.2 Berrypicking and information encountering

To Bates (1989) interaction with IR systems is best characterised as *berrypicking* and she has developed *berrypicking* as a model for searcher behaviour in interactive IR systems. She argues that the search process is best characterised as evolving, that is, users search for information a "bit-at-a-time" using various techniques. Each new piece of information a searcher encounters gives new ideas and directions to follow, and consequently a new conception of the query. Thereby Bates highlights the iterative nature of users' search processes and challenges the classic model of IR as searching based on a stable topical need: "As a formal model for testing, it [the classic model] has taught us much; as realistic representation of actual searches, it has many limitations. As a consequence, as long as this model dominates information science thinking, it will limit our creativity in developing IR systems that really meet user needs and preferences" (Bates, 1989).

The *berrypicking* model is a further development of an earlier so-called "exploratory paradigm" primarily focusing on browsing, as active undirected information seeking where explicit queries do not have to exist (Bates, 1986). However, Bates (1989; 2007) emphasises the clear distinction between berrypicking and browsing. She explains how berrypicking characterises episodes of information searching as a process involving a variety of search techniques (directed searching, browsing, scanning, backwards and forward chaining etc.) and a wide variety of information sources. The berrypicking model is later empirically validated, e.g., in the well known Getty online searching project studying humanities scholars' seeking behaviour (see for example Bates, 1996). In the context of the matrix model presented above (section 4.4.1), berrypicking behaviour is best associated with *well-defined but variable* information needs, where both querying and exploratory navigation takes place. However, also browsing takes place during berrypicking, suggesting transition towards an ill-defined information need.

Even though the berrypicking model was proposed 20 years ago, and the breakthrough of the Internet has occurred along the way, it continues to challenge the classic model of IR. For example, by stressing the equal importance of directed and undirected searching and the notion of the evolving search. The latter suggesting us to investigate the dynamism of session-based interaction. In many ways the berrypicking model forestalled the typical searching behaviour in Web surfing strategies where browsing and scanning activities are widely used.

In line with Bates, Erdelez (Erdelez, 1997; 2000; 2005) also takes an exploratory approach to information behaviour and focuses on accidental information discovery. Erdelez introduces the concept of *information encountering* defined as "…an instance of accidental discovery of information during an active search for some other information" (2005, p. 180). She uses the term *information encountering* to describe the distinctive type of information acquisition that occurs when an individual is browsing or scanning the information environment. Based on a qualitative research design she found that information encountering was an integral part of the browsing and information seeking activities performed by the study participants (students and employees in an academic setting), who were categorised as super-encounterers, encounterers, occasional encounterers, and non-encounterers. The key characteristic of information encountering is that it is an entirely random and unpredictable information behaviour, which occurs within random browsing and environmental scanning (Erdelez, 1997). Accordingly, information encountering can be placed in the lower half of the matrix model presented above (section 4.4.1). A follow-up study, addressing information encountering on the Web, shows that the information density of the Web provides an opportunity to have more information encountering (Erdelez, 2000).

Finally, it should be noted that Erdelez work is closely connected to the concept of serendipity, that is, when people find information not planned for (e.g., A. Foster & Ford, 2003). The concept of serendipity has been approached from several perspectives within information science including both digital and non-digital information environments (e.g., Björneborn, 2008; Erdelez, 1997; A. Foster & Ford, 2003; Ross, 1999). A main question is how information systems can support accidental or serendipitous discoveries. Serendipitous discoveries occur both when querying and browsing, however, serendipity is often linked with browsing: "…people find valuable information on subject B when searching for subject A, a phenomenon often called *serendipity*. The very act of browsing allows a user to recognize information of value in other contexts than that in mind when the search was started (Boyce, Meadow, & Kraft, 1994, p. 177). The following section addresses browsing strategies and motives for browsing.

4.4.3 Browsing strategies and motives for browsing

In general, *browsing* is an approach to information seeking that is informal and opportunistic and depends heavily on the information environment (Marchionini, 1995).

In their review of literature on browsing, Chang and Rice identify "…browsing as a rich and fundamental human information behaviour" (1993, p. 263) that is crucial for a complete understanding of information seeking. Extensive literature exists on browsing including various typologies of types of browsing in different environments. It is not relevant here to discuss the many contributions to the area of browsing. Rather, based on Marchionini (1995), three main types of browsing are described, relevant for the analysis of searching behaviour of the virtual museum visitor (see section 7.4). Afterwards, motives for browsing is shortly discussed in order to come closer to an understanding of what drives the virtual museum visitor's (perhaps) fuzzy and non-goal directed information behaviour.

Differentiated by the object of the search and the tactics employed, the following three main types of browsing are identified (Marchionini, 1995, p. 106):

- Direct or specific browsing, which is systematic and focused and often driven by a specific object. An example is scanning a list of, e.g., descriptions of museum artefacts for a known item. *Scanning* is seen as a recognition activity that compares sets of well-defined objects with an object known to the seeker (Marchionini, 1995, p. 111). Scanning is one of several browsing strategies.
- Semi-directed and predictive browsing, which proceeds less systematically. An example is casually examining of records returned, when entering a single general term, e.g., 2nd world war, into the museum catalogue.
- Undirected or general browsing, which has no real goal and very little focus. An example is casual and unsystematic browsing across web sites of interest in relation to your hobby.

The present thesis will apply these three main types of browsing in order to describe virtual museum visitors' information seeking activity. In general browsing can prove particularly effective for information problems that are ill-defined or where an overview of an area is needed. However, it should be added that during an IS&R session both searching and browsing may occur and blend. Likewise, the searcher may move from one of the four instances of information needs (see Table 4.1 above) to another as the searcher's knowledge evolves. A distinction should be made between browsing and berrypicking. Berrypicking characterises whole episodes of information searching with an evolving query, which shifts during the course of the search (Bates, 2007). A berrypicking search can include varying searching techniques, including browsing.

Besides the very overall motives for browsing, ill-defined information problems and gain an overview, an important additional motive for browsing is identified by

Toms (1999). Her investigation includes play theory in describing the experimental results on electronic newsreading. Toms finds support for a curiosity- or play-driven interpretation of browsing text. Thus, Tom's results suggest that browsing is more closely "…connected to satisfying human curiosity than to resolving a predetermined information gap or need" (1999, p. 204). A parallel can be drawn to how, in a situation with an ill-defined and variable information need, motivation and curiosity of the searcher may make the search session progress (Kuhlthau, 1991). In a similar vein, also Bates (2007) discusses motivations for browsing. In continuation of her earlier work on the exploratory paradigm, she also stresses the importance of curiosity for the in-built motivation for browsing and exploratory behaviour.

A common finding in the above studies of browsing is a call for more findings of exploratory behaviour in order to inform information system design to incorporate facilities for browsing.

4.5 Summary

The chapter consists of four main sections related to information seeking in work and leisure task contexts. Together they form the theoretical background on information seeking behaviour needed for guiding the methodical design of the case study and analysis of results. As a continuation of chapter 2, the first section outlines task-based IS&R research from both a theoretical and empirical perspective. In accordance with the integrative cognitive framework (Ingwersen & Järvelin, 2005) the present study follows applies a broad definition of work task also to include leisure tasks. Therefore both museum curators and virtual museum visitors' information seeking behaviour is examined from a work task perspective in order to connect the task and derived information need with the search process and analyse how they interact. Emphasis is placed on Byström and Järvelin's (1995; Byström, 2002) empirical studies of work task complexity as these studies inspired the research design regarding professional museum curators.

The second main section approaches information seeking in everyday life context. Savolainen's (1995) ELIS framework is introduced and seen as complementary to the integrative viewpoint adding further layers and identifying contextual factors, e.g. personal values and social aspects of information needs, relevant to consider to gain an understanding and characteristic of the (small part) of everyday practices analysed in the case study. In addition, inspired by Hartel's (2003; 2006) empirical work in leisure context we apply Stebbins's (1982; 1994; 2007) distinction between different types of hobbyists.

The third section reviews information seeking studies related to both historians and professionals within cultural heritage. Only very few information seeking studies exist specifically on museum professionals. Amin et al. (2007) is a notable exception. Instead, useful parallels are drawn from related studies of historians' information seeking.

Finally, given our hypothesis of virtual museum visitors exploratory information seeking behaviour, Bates's berrypicking model and Erdelez's framework for information encountering are valuable in the present study. They provide insight into seeking behaviour reflecting explorative information needs and interests. Further, the interplay between directed and undirected searching identified in the case study will be discussed in section 7.4.

5 Research method

This exploratory case study of information seeking behaviour in a digital museum context is based on a mainly qualitative research design. The research design was directed by two primary concerns: 1) involvement of real users and systems in real-life situations; and 2) relating findings of information seeking behaviour to system design and representation of museum artefacts. Both aspects relate to the integrated framework for IS&R, which serves as the theoretical frame for the study. In addition, the research design was directed by a third concern, namely the possibilities and constraints of the specific case: the Military Museum.

The empirical investigations of the case study were conducted by applying several data collection techniques. This chapter describes and explains the methodical approach. The first section describes the methodological considerations and provides an overview of the different data collection techniques applied. The second section introduces the empirical setting. The third and fourth section outlines the research methods regarding the two main user groups, the museum professionals and the hobbyists, respectively. Finally, the last section provides a summary.

5.1 Methodological considerations and overview of research methods

Earlier, empirical studies of information seeking predominantly used quantitative surveys based on structured questionnaires as data collection method. But as part of the more holistic user-oriented approach, gaining momentum during the 1980s, qualitative research methods were introduced (Ingwersen & Järvelin, 2005, p. 87-88). Early examples of this are Wilson (1981) who suggested qualitative research to be particularly appropriate to the study of needs underlying information-seeking behaviour, and Fidel's (1984) pioneering application of the case study method within library and information science research to differentiate broad patterns of behaviour. This development in choice of research method signifies a move from descriptive studies to more explanatory studies aiming to provide understanding of the research phenomenon in question. A turn towards a more holistic approach to IS&R further implies a growing level of complexity, as all the cognitive actors taking part in the IS&R process, and the relationship between them, are considered. This applies, e.g., to the integrated cognitive viewpoint and accordingly Ingwersen and Järvelin stress the importance of including qualitative research strategies: “We consider qualitative methodology a necessity in order to further develop the understanding of cognitive actors in the IS&R process” (2005, p. 109). Also Glazier (1992) relates the growing use of qualitative research methods in library and information science to the complexity of research, and states that flexibility and multiple perspectives are important to convey all relevant parts of the research object under investigation.

The present case study is based on a, primarily, qualitative approach and data collection was carried out in close connection with the subjects and situations studied. Detailed, qualitative data were gathered by applying several data collection methods and research techniques, including in-depth semi-structured interviews based on the critical incident method, a web questionnaire survey and simulated work task situations (the two latter resulting in both quantitative and qualitative data). The exploratory nature of the study is supported by applying more than one method, as different methods reveal different aspects of the case. This triangulation of research methods is recommended to increase the validity of the results (e.g., Frankfort-Nachmias & Nachmias, 2000, pp. 189-190). The advantage of triangulation is that by cross-checking data from multiple sources and by using multiple methods, the limitations and partial evidence of one method is complemented by strengths of other methods.

Section 5.3 and 5.4 give detailed descriptions of the different methods applied for each of the two main user groups. First, however, section 5.1.1 provides an overview of the data collection process and methods applied, and 5.1.2 discusses the case study as a research strategy.

5.1.1 Overview of research methods

As stated above, multiple techniques were used to provide a rich characteristic of both museum professional’s and virtual museum visitors’ information seeking behaviour in a digital museum context. Each technique served a unique purpose in the design. First, before and during the actual data collection process, informal knowledge gathering took place in order to provide insight into the museum sector in general and the case museum in particular. The gathering of informal knowledge is not seen as actual data collection, but is rather seen as a preparatory and supporting activity. Secondly, in relation to the museum professionals, in-depth interviews provided characteristics of curators work tasks and derived information needs. Thirdly, in relation to the virtual museum visitor we started by analysing written enquiries (both e-mails and letters) to the museum. Even though the written enquires do not (necessarily) reflect the virtual museum visitor, they provided invaluable information on interest areas, types of information needs, vocabulary used etc. They helped guide the design of the following online web questionnaire survey and user study. The web survey served two purposes. To provide background information on the virtual museum visitor and what he/she is looking for *and* recruit participants to a user study. Finally, the user study covered two parts. The first part focused on participants interactions with the online museum catalogue. This part builds upon simulated work task situations (Borlund, 2000b). The second part was a semi-structured interview providing higher level information on the participants' information seeking behaviour and interest areas.

An overview of the data collection methods are shown in Figure 5.1. The arrows between the different methods indicate that findings from each component both contribute to the following steps in the data collection process *and* to the final characteristics of seeking behaviour. Finally, a timeline of the data collection process is shown in Figure 5.2. This section serves as an overview. A thorough description of the methods applied is given in the following sections of this chapter.

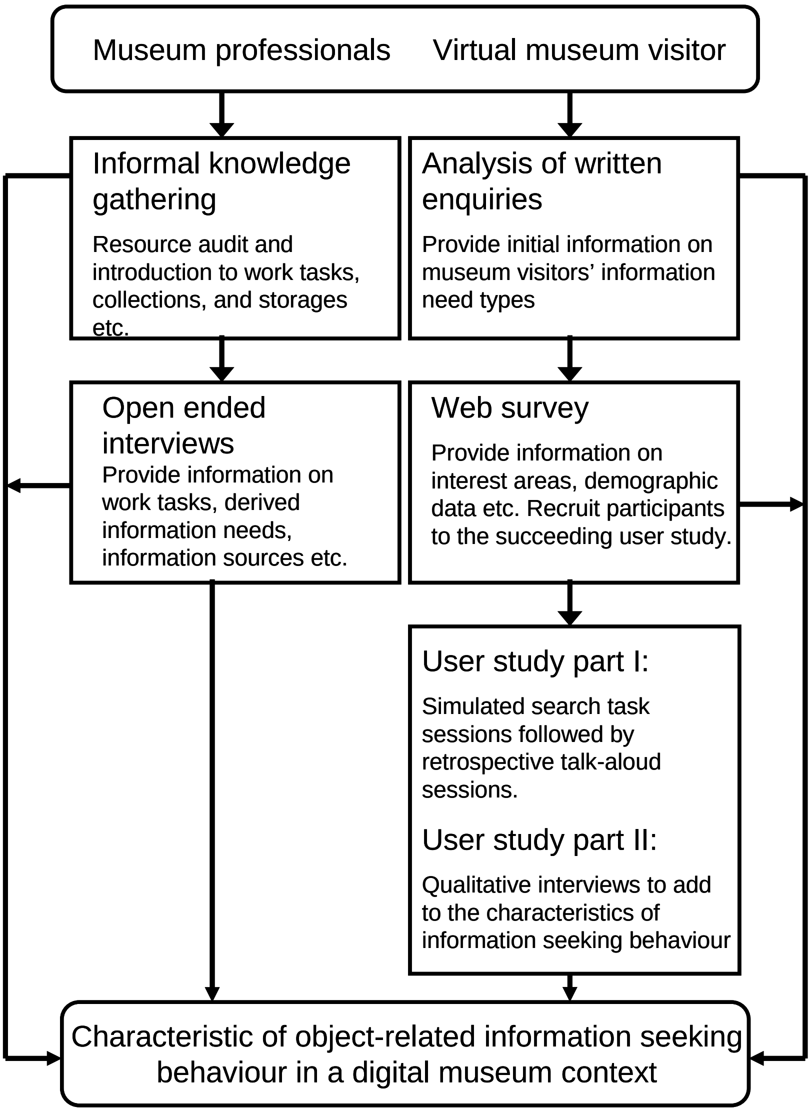

Figure 5.1 Overview of the data collection methods applied

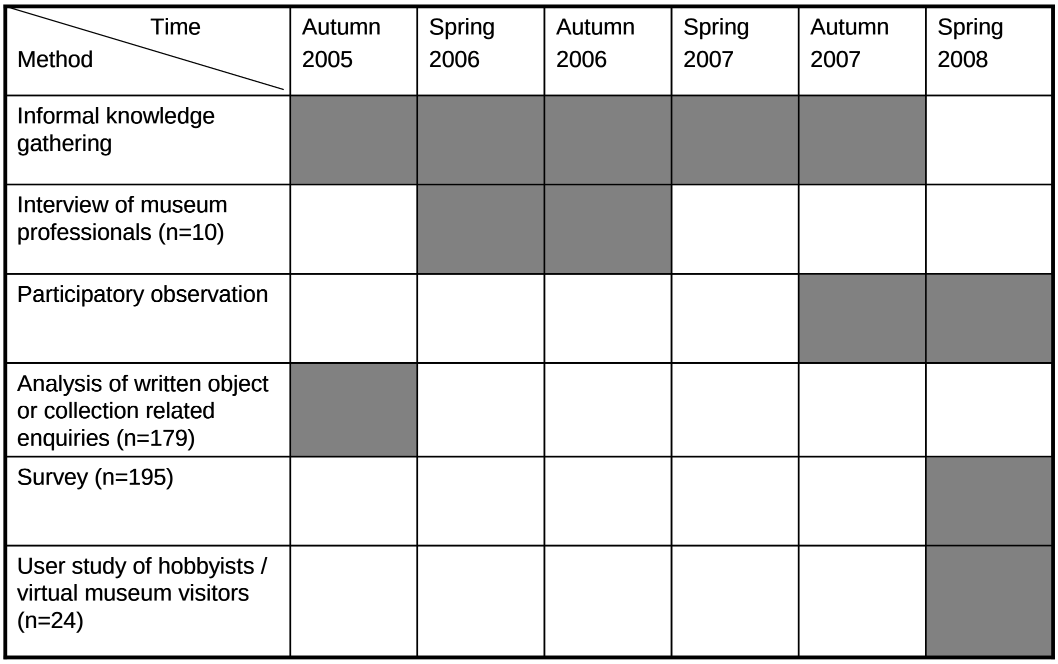

Figure 5.2 Timeline of data collection process

5.1.2 The case study approach

The case study as a research strategy is characterised by emphasizing a single entity and its context. According to Fidel (1984), it is an appropriate method for studying a phenomenon with a large variety of factors and relationships. The case study investigates real-life phenomenon and attempts "…on the one hand, to arrive at a comprehensive understanding of the event under study but at the same time to develop more general theoretical statements about regularities in the observed phenomena" (Fidel, 1984, p. 274).

Stake (2000) presents three types of case studies: 1) the *intrinsic case study* focuses on the case itself, e.g., to obtain a better understanding of that particular case; 2) the *instrumental case study* examines a case mainly to obtain and provide insight into an issue or to redraw a generalization; and 3) the *collective case study* which is an instrumental case study extended to several cases. Using Stakes terminology, the case study strategy employed in the present work is best described as an *instrumental case study*, because the case is used to provide insight into information seeking behaviour in a real-life museum context. Hence, the case itself is of secondary interest, but plays a supportive role by facilitating our understanding of the problem of phenomenon in focus. When analysing data from case studies, the focus is of the often on the search for patterns, explanations of causal relationships and analysis of change over time (Wang, 1999). Further, data analysis in qualitative case studies is largely based on inductive generation of theories, models and/or hypothesis from empirical data, rather than hypothetic deduction.

The present case study, however, also includes elements known from the *field experiment* research strategy. Similar to case studies, field experiments seek to retain realism of the study setting by including real actors in a natural setting and context, as far as possible. But the experimental setup allows more control of the test persons and their procedures (Ingwersen & Järvelin, 2005, p. 246). In the present work this is done in the first part of the user study of virtual museum visitors by means of assigned search tasks. Because of the experimental setup, comparison across participants and search tasks could be made, thus adding to the explanatory strength of the study.

A case study constitutes an inquiry into a *single* case and therefore generalizations can often be hard to make. Thus, a constant concern in case studies is whether the unit observed (in this case, curators and virtual visitors at a particular museum) is representative of others in the population (i.e., all curators and virtual visitors at cultural museums). However, Case (2002) points out, that case studies can be made more rigorous when they include more data collection methods, diverse sources of evidence and multiple times of observation. Further, a holistic and process-oriented emphasis on case studies can also improve the case study strategy (Case, 2002). In the present study, this is reflected by employing a triangulation of research methods (see section 5.1.1) and instead of a "one-shot" design focusing on a single point in time, the present researcher had the opportunity to spend considerably time at the case museum both before and during data collection process (see Figure 5.2 and section 5.2).

Finally a comment on the representativeness of the case study. Even though we do not have a reason to think that this particular case is radically different from other cultural museums, representativeness is not the main aim of this case study. Instead, specific conclusions are drawn and, as the research questions reflect, the study aims at characterising information seeking behaviour of the two main user groups. The characteristic includes addressing the "why" questions that research strategies, like surveys and experiments, usually do not address very well.

5.2 Empirical setting

As mentioned in chapter 1, the present research project was established in cooperation between the Military Museum, the Danish Ministry of Culture, and the Royal School of Library and Information Science. Within this cooperation, the empirical framework of the present study was established and the Military Museum formed the empirical setting. The research approach and the chosen aspects to be investigated were decided by the present researcher.

The following two sub-sections outline the empirical setting. That is, introduce the case study and the museum's online catalogue.

5.2.1 Introduction to case: the National Museum of Military History

The National Museum of Military History (in short the Military Museum) is a government approved institution under the Danish Ministry of Cultural Affairs. Situated in central Copenhagen it is a museum of cultural history, covering the history of the Danish defence and development of weapons from the introduction of firearms to the present day. The Military Museum was founded in 2004 when The Royal Danish Arsenal Museum (in Danish Tøjhusmuseet) and The Royal Danish Naval Museum (in Danish Orlogsmuseet) were merged. The Arsenal Museum[30] and The Naval Museum[31] both have a long history and the collections can partly be traced back to the 17th century. The primary purpose of the Military Museum is:

1. To present the history of the Danish defence and development of weapons
2. To collect, preserve and exhibit the cultural heritage artefacts related to Danish defence history, and
3. To carry out research

It is a medium sized museum and today the highly heterogeneous collections comprise approximately 200.000 museum objects related to Danish defence history and the development of weapons (Christensen, 2006). The heterogeneous collections cover a

[30] The Royal Danish Arsenal Museum was founded in 1928. Its collections can partly be traced back to the beginning of the 17th century when the Danish King Christian the 4th founded a weapon collection. Link to the museums web site: www.thm.dk

variety of different media including three-dimensional objects, text documents, photographs, sound recordings and video. Furthermore the collections are characterized by complex inter-relationships (e.g. people, objects, activities, places, and time) and by museum artefacts having multiple contexts and changing relationships. The diversity of the collections can be illustrated by the fact that the collections cover artefacts ranging from 16th century firearms, over medals and uniforms to an F-16 military aircraft. Between five and ten percent of the objects are on display, and there are more than 80.000 visitors[32] a year at the two sites (Statens Forsvarshistoriske Museum, 2008). The staff count about 30 persons' work in one year covering approximately 60 employees including a number of part time employees, e.g., student guides and museum attendants. The present study concentrates on the academic staff, counting eight curators, a vice director and a director, at the time the interviews were conducted (summer 2006). See further in chapter 6.

The Military Museum can be described as a traditional museum of cultural history. However, during the last decade the museum has started a process of transformation. Earlier the museum had a narrower, typological focus on weapon history. Now the museum aims at becoming a museum of defence and weapon history with a broad cultural historic perspective (Christensen, 2006). The process is driven by management and the curatorial staff's professional ambitions, but also influenced by a general trend in the public and a political awareness on, e.g., making the museum's collections accessible on the internet. To some extend, parallels can be drawn from the process of transformation taking place at the Military Museum to the shift of paradigmatic nature, outlined in section 3.1.1, from the traditional museum to the reinvented museum. The following four elements are major visible examples of the transformation taking place at The Military Museum:

- Collections are digitized and successively made accessible online
- Acquisition and research is seen as part of the same process. The idea is to tell a specific story, and artefacts are gathered as they relate to the story (Christensen,

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[31] The Royal Danish Naval Museum was founded in 1957. Link to the museum web site: www.orlogsmuseet.dk

[32] The precise number of visitors was 83.282 in 2006 and 80.002 in 2007. The number includes visitors to the two main sites, The Arsenal Museum and The Naval Museum, and also guided tour visitors to the museum's three vessels from the Cold War era.

2006). The same methodological approach to acquisition is described by Hooper Greenhill (1992, p. 206) and Jessen (2005).

- Contextualisation of museum artefacts. Focus on the documentation and indexing of museum artefacts is changing. Earlier focus was on the description of the visible features of the artefact and placing it within a typological classification. Now focus is on telling the story of the artefact and demonstrating the links that the artefact makes with other artefacts. Links related to events, people, places, time, classification, etc.
- A new permanent exhibition (in the physical museum) is on the drawing table. The overall exhibition theme is 'War & Man'. The forthcoming exhibition aims at telling stories, asking questions, and showing multiple viewpoints - as opposed to being a voice of authority (Tøjhusmuseet, 2005).

The ongoing development process influences the Military Museum in a number of ways, for instance, in relation to internal work practices and new means of presenting cultural history to the museum's visitors. Given these circumstances, combined with the extensive and highly heterogeneous collections, the Military Museum makes a highly interesting case study.

5.2.2 The Military Museum's online catalogue

As part of the Military Museum's efforts in providing online access to its collections, an online catalogue of museum objects was launched in 2004. Later, in early 2008, an improved version of the catalogue was launched. This new version of the catalogue was used as empirical test system for the user study of virtual museum visitors' information seeking behaviour. This section describes the online catalogue[33].

The online catalogue is an interactive web based catalogue providing images and related information of 1705 three-dimensional artefacts. The 1705 artefacts (primarily hand weapons) included in the online catalogue form a subset of a large, historic collection illustrating the history of weapon development. It is a unique collection treasured by military historians and it has been on display at the Arsenal Museum at least 50 years (Tøjhusmuseet, 2005). The exhibition, however, will be heavily reduced and put on storage to make room for a new permanent exhibition. In this way, this online catalogue

[33] Link to the online catalogue: www.thm-online.dk. The text in the online catalogue is in Danish.

is an instrument to secure online access to (part of) an earlier exhibition. The future aim of the online catalogue is to successively add more items and new layers of value-added information. Due to the relatively limited topical coverage of the online catalogue at present, the expected audience is mainly dedicated amateurs with some background knowledge of the area.

Access to the online catalogue is provided from the homepage of The Military Museum. From the front page of the online catalogue there are two main ways in:

- *Browsing through historical eras*. The user can browse through 21 historical events (that is, wars that Denmark has taken part in from the year 1500 and forward) and their related artefacts. A screenshot of the browsing interface is shown in Figure 5.3**.** The browsing interface reflects the two facets of time and event. Further, the browsing interface is designed to reflect the outline of the new permanent exhibition, thus aiming at creating a link between the physical and virtual museum.
- *Analytical facet searching*. A simple free text search window/field. The free text search can be limited, by drop/pull down menus, with the following facets:
    - *What*: type of artefact (three levels of artefact categories: 1) a main category, e.g., weapons or personal equipment; 2) a sub category, e.g., hand weapons, edge weapons, or optical instruments; 3) an artefact category, e.g., bayonets, flintlock pistols, or military uniform jackets.
    - *When*: time of production *and* time of accession
    - *Where*: place of production *and* place of use

  The drop-down menus available to the user to choose from are dependent on the fields within the database. The drop menus dynamically adapts during a search session. That is, if a user selects a specific artefact category, the values in the other drop down menus are updated to reflect this choice. In this way the user is supported in successful searches. Firstly, the user is helped to avoid queries with no matching records (e.g., ‘airplane’ and ‘1864’). A screenshot of the search interface is shown in Figure 5.4.

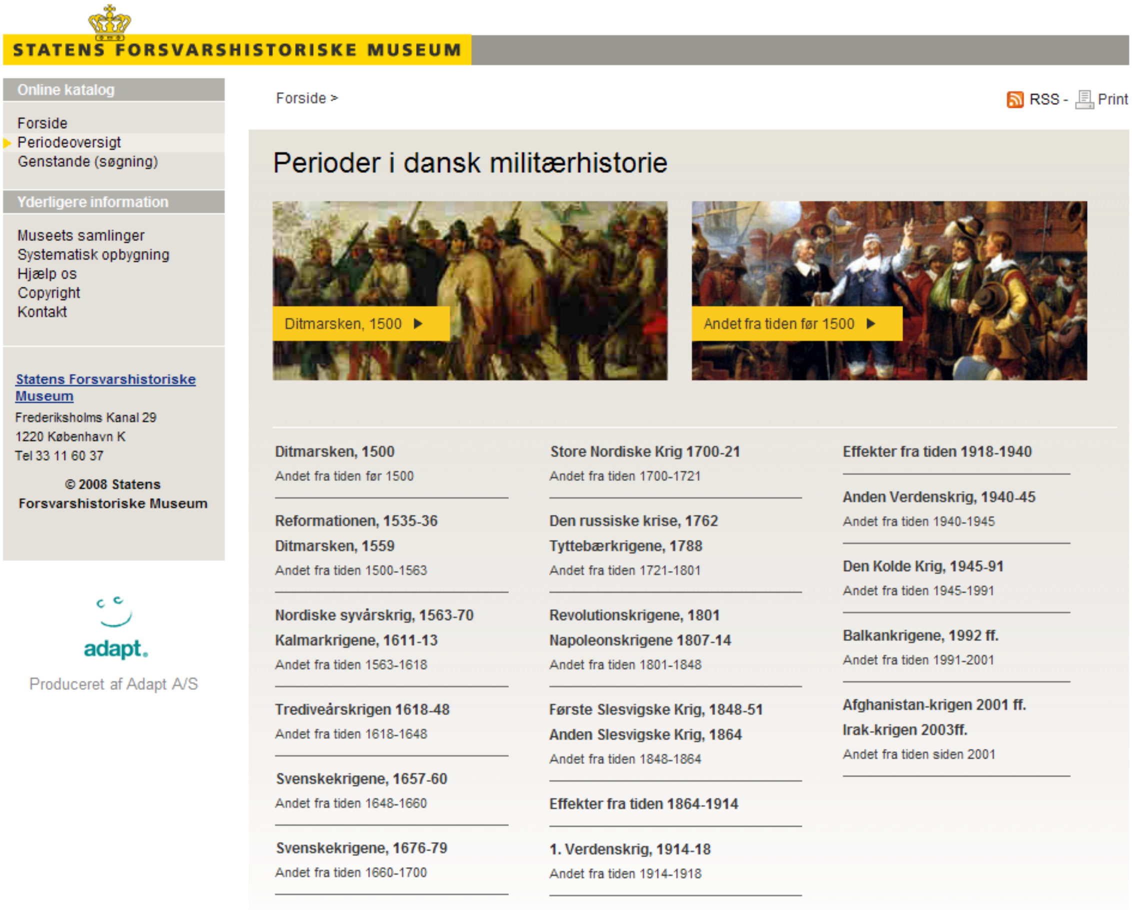

Figure 5.3: Screenshot from the Military Museum's online catalogue: the browsing interface

The metadata in the online catalogue is a sub-set of data from the original catalogue cards. The retrieved artefacts are presented in the search result list with a short textual description (name of artefact, time of production and time of use) and a thumbnail image (see example in appendix 1). Each artefact record includes the following content:

- A record (see example in appendix 2) with a short textual description, a zoomable photograph of the artefact, and a list of metadata:
    - Administrative: museum number, accession date
    - What: name of artefact, artefact type, physical measures and weight
    - When: time of production, time of use
    - Where: place of use, place of production
    - Who: used by [person or group], manufacturer

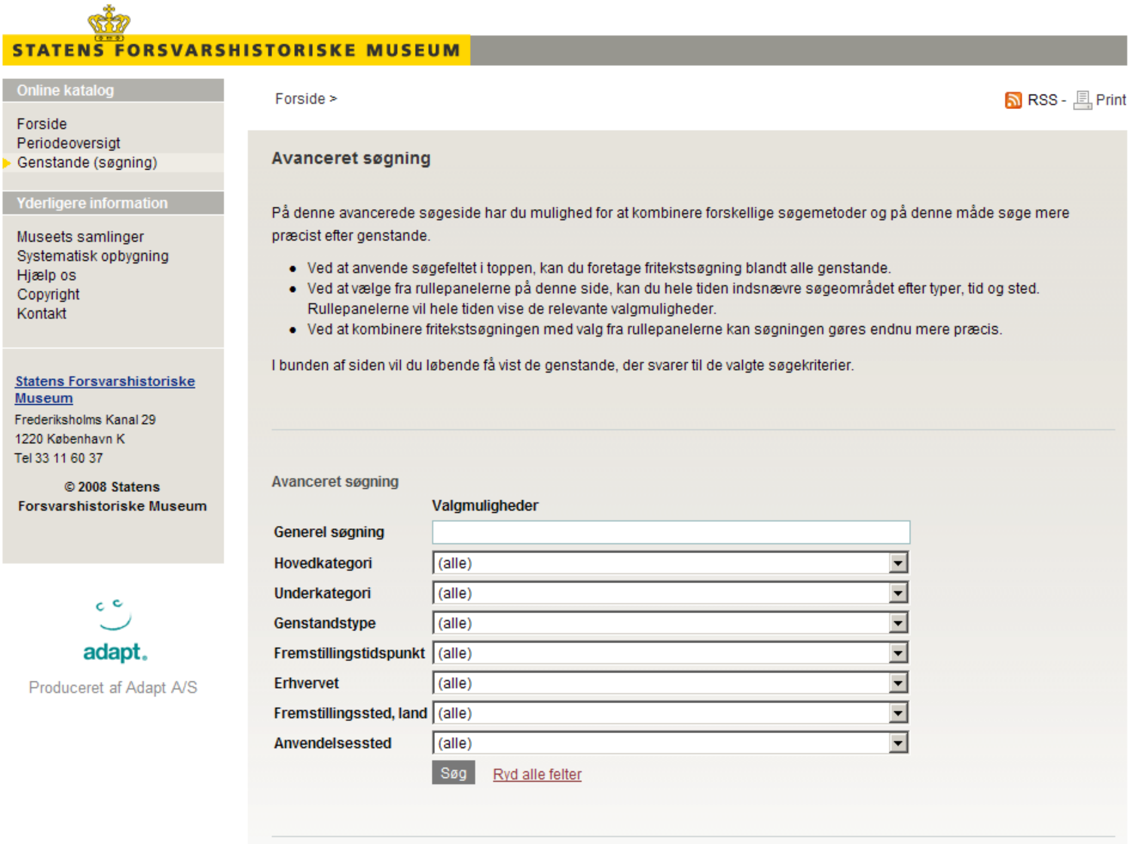

Figure 5.4: Screenshot from the Military Museum's online catalogue: the analytical search interface

The information included in the metadata is derived from the original registration material, see below, and entered into the catalogue database. All information in the main record is searchable. In addition, the following material is attached to a record:

- Large photo of the artefact. Available in all records.
- The original catalogue card (scanned material, not searchable). Available in all records.
- Original prose descriptions of primarily physical and technical aspects of the artefact (scanned material, not searchable). Available in about 50% of the records.
- The original accession protocol providing brief provenience and accession information (scanned material, not searchable). Available in about 50% of the records.

Where the main records provide access to the most important information in a well-structured form, the attached original registration materials provides access to more detailed information. In general, the online catalogue provides access to a wealth of information not previously accessibly for non-professional, external users.

Even though the online catalogue, at present, contains relatively few items, it is considered a suitable collection for the simulated search task experiments with the virtual museum visitors. The simulated search tasks given to the test participants are designed to reflect topics that the online catalogue covers well, thereby compensating for the narrow focus of the catalogue. In relation to the museum curators, on the other hand, a similar simulated search task experiment was regarded unrealistic and was therefore *not* conducted. Based on informal knowledge gathering in the beginning of the research project, it was clear that the topical diversity of the museum curators' work tasks and derived object-related search tasks could not be covered in the online catalogue. This was later supported by the interviews of the museum curators (see chapter 6). Accordingly, different data collection strategies were designed for the two user groups. They will be outlined in the following section 5.3 on museum curators and section 5.4 on virtual museum visitors.

5.3 Research design regarding museum curators

The main data collection method was semi-structured in depth interviews with curators at the Military Museum. Qualitative interviews were chosen as the main data collection method in order to cover a wide range of work tasks and their correlations with aspects of information seeking behaviour according to the research questions. Characteristics of work tasks would have been difficult to collect based on, e.g., observation as object-related search tasks related to the different work tasks do not occur daily. Further, simulated search task situations were not realistic to conduct in existing information systems (see above), and in general the pre-study (see 5.3.1) indicated that existing information systems were not meeting the needs of the museum curators.

The following sub-sections outline the methodical approach chosen to explore and characterise the information seeking behaviour of museum curators in an integrated work task perspective. First, section 5.3.1 informal knowledge gathering aimed at qualifying the following data collection and analysis process. Next, section 5.3.2

outlines the design of the interview guide and the process of data collection and analysis.

5.3.1 Pre-study: informal knowledge gathering

As mentioned in chapter 1 and in section 5.2, the present research project was established in cooperation between the Military Museum, the Danish Ministry of Culture, and the Royal School of Library and Information Science. Accordingly, it was *unproblematic* to gain access and get permission to collect the chosen empirical data in relation to the professional museum curators, publish a web questionnaire survey on the Military Museum's web site (see section 5.4.2.2), and use the Military Museum's facilities to conduct user studies of virtual museum visitors (see sections 5.4.3 and 5.4.4). Further, as part of the PhD work the present researcher had the opportunity to spent, in average, a day per week at the Military Museum throughout the duration of the PhD project. It was an opportunity to gain insight into the museum's work practices and the domain of defence and military history.

The purpose of this informal information gathering was not to collect empirical data as such. Instead, the purpose was primarily to qualify the research design and the following data collection and analysis. The informal knowledge gathering included participating in two monthly staff meetings, an introduction to the Military Museum's registration policy and practice, and an introduction to the collections, exhibitions and storages. Finally, resource audit of different sources included assessing examples of the Military Museum's object records and reading of other publications central to understanding work tasks at the Military Museum, e.g., a research article on the museum's collection strategy (Christensen, 2006), an outline for a new permanent exhibition at the museum (Tøjhusmuseet, 2005), and the Military Museum's annual reports.

5.3.2 Semi-structured in-depth interviews

The purpose of the qualitative interviews was to gain an in-depth understanding of professional museum curators' work tasks and object-related information seeking behaviour. Even though focus was on object-related information seeking behaviour, the interviews included a somewhat broader approach in order to capture the organisational and work task context of the curators' seeking behaviour (in line with Ingwersen and

Järvelin's (2007) generalised model of information seeking and retrieval - see Figure 2.4).

The following three sub-sections elaborate the methodology in relation to the interviews and describe the design of the interview guide, how the data was collected, and the process of transcription, coding, and analysis.

5.3.2.1 The interview guide

The aim of the interview guide was to provide a systematic and comprehensive approach to the interview process. The interview guide (appendix 3) shows how the first main part of the interviews focused on gaining an overview of characteristics of different task types. In the second part, the critical incident technique (Flanagan, 1954) for data collection was applied. This interview technique focuses on a concrete incident to collect data on a phenomenon and according to Ingwersen and Järvelin the strength of the method is that it relates the use of information to the problem solving process (2005, p. 91). The critical incident technique has been applied in several studies of information seeking and behaviour (e.g., Sonnenwald & Pierce, 2000; Zach, 2005). Each part of the interview process is explained in the following.

After a short introduction to the interview, participants were asked to describe shortly their main work tasks and the types of information sources generally used in these tasks. They are also asked to give examples of recent incidents information needs related to those tasks. The purpose was twofold. First, according to Kvale (1997) a contextual and experience-based opening is important as a way to frame the rest of the interview. Second, participants' initial description of their work tasks provided an overview and allowed the interviewer to make an informed decision on which critical incidents to focus on in the remaining part of the interview. The interviewer' selection of critical incidents to focus on in the remaining part of the interview was based on 1) recency, 2) covering of different task types, and 3) that the information seeking task is (partly) object-related. Recency is important to minimise retrospective bias due to participants' limited ability to recall the concrete incident (Urquhart et al., 2003). Each participant is asked to describe one or two critical incidents.

The second part of the interview focuses on the critical incidents. The informal knowledge gathering from the pre-study (section 5.3.1) indicated that work tasks of museum curators take a range of varying length and complexity. From a work task perspective earlier research has indicated systematic relationships among task complexity and types of information needed, information channels, and sources (Byström & Järvelin, 1995; Byström, 2002). See also section 4.1.3. Based on these findings the interview guide is inspired by Byström and Järvelin's (1995) study of work task complexity. Accordingly participants are asked to describe:

1. The specific work task (including sub-tasks, complexity based on a priori determinability, and ambition level)
2. Derived information need(s)
3. Use of information sources and channels
4. Type of information needed

Again, the informal knowledge gathering during the pre-study helped the interviewer to probe questions to provide explicit examples of, e.g., sources.

5.3.2.2 Collecting the data

In order to obtain an as full and rich picture of the case study as possible, interviews were conducted with all ten members of the academic staff at the Military Museum at the time of data collection. The academic staff counted eight museum curators, a vice director and a director at the time the interviews were conducted (summer 2006). It should be noted, that later analysis of the interviews showed that the work tasks of the museum director only marginally covered work tasks including object-related information seeking aspects. Therefore only minor parts of this specific interview were used in the further analysis.

The average age of the curators was 44.4 years. Eight of the curators had been employed at the Military Museum more than ten years, one curator had been employed for five years, and the last curator had been employed only a single year. Eight of the museum curators had higher education in the area of history, one in ethnology and one in ethnography. Three had a post doctoral degree and seven had master degrees. The curators counted eight men and two women.

In large museums, employees may have clearer and more specific expert roles compared with smaller museums, where one professional takes responsibility for several expert roles (Amin et al., 2007). The latter is the case at the Military Museum and thus no distinction will be made in the present thesis between different roles of museum experts, like researchers, curators, and registrars. Point of departure is museum professionals' object-related work tasks. Accordingly, the term 'curator' will be used in the following to cover all ten museum professionals.

All interviews were conducted in the Military Museum's administration building, primarily in the curators' own offices.

5.3.2.3 Transcription, coding, and analysis of interview data

The interviews were digitally audio-recorded and covered and the interviews lasted in average one hour and 12 minutes. To prepare the interviews for qualitative analysis they were transcribed into text. During the transcription process time stamps referring to time stamps on the audio files were added at regular intervals. This was done to ease locating specific sequences later in the analysis process. All transcripts were provided with a participant ID name and number together with the date and duration of the interview. The interviews were transcribed word-to-word by the present author. Likewise, quotes from the interviews included in the present thesis were also translated from Danish into English by the present author.

After transcription was completed the text files were imported into the qualitative analysis software ATLAS.ti version 5.0. The software assists in moving pieces of raw data into thematic groupings and provides a systematic approach to handling unstructured data. The ATLAS.ti software is based on the grounded theory approach (see, e.g., Strauss & Corbin, 1998), and it has earlier been used to analyse interviews in studies of user behaviour in library and information science (e.g., A. Foster, 2005; Hyldegård & Ingwersen, 2007; Hyldegård, 2009; Wilson, 2004).

The primary method of analysis was inductive content analysis, and no formal testing of hypotheses was attempted. In the context of studies of users' cognitive behaviours, Schamber describes the use of inductive content analysis as a "…set of techniques for making inferences from text about sources, content, or receivers of information" (2000, p. 735). Schamber explains how inductive content analysis is particularly appropriate for research which derives theory from data rather than verifies existing theory. In the present case study, the process of developing categories and a coding scheme was primarily inductive. However, prior to the coding process a rough outline to a coding scheme was constructed based on the interview guide which obviously reflected the research questions related to museum professionals. From the beginning the qualitative analysis focused on the identification of themes, categories of work tasks, information needs, preferred data elements and sources, and correlations between work tasks and information seeking behaviour. This said, the coding scheme was elaborated and refined through several iterations of coding and analysis.

The initial coding was based on what Strauss and Corbin define as *open coding*: "[t]he analytical process through which concepts are identified and their properties and dimensions are discovered in data" (1998, p. 101)). Based on thorough reading of transcriptions this initial coding both verified the rough outline of the initial coding scheme *and* identified novel concepts and their properties. As an example of a novel concept, the transcripts showed how several curators repeatedly addressed the concept of 'what constitutes a good museum object'. Further analysis showed how this central concept was interrelated with several work tasks, preferred data elements and a historic perspective on resource description (see 6.2).

After the initial coding, iterations of focused coding took place including both open and axial coding. *Axial coding* refers to "the process of relating categories to their subcategories, termed "axial" because coding occurs around the axis of a category, linking categories at the level of properties and dimensions" (Strauss & Corbin, 1998, p. 123). For instance, codes representing different information sources were grouped and use of sources was related to task types.

Data collected in this part of the study are reported using a numeric ID number to refer to each museum curator (1-10), whereas data collected in the user study of virtual museum visitors are reported using an alphabetic ID number to refer to each of the 24 participants (A-Y).

5.4 Research design regarding virtual museum visitors

As described earlier, the present study of virtual museum visitors' information seeking behaviour focuses on non-professional users in a leisure context. A focus which is directed by the fact, that this visitor group is the primary target group of the museum's online catalogue, the majority (76%) of written enquiries comes from this group, and results from the web questionnaire survey show that 67% of the respondents visited the online catalogue in a hobby/leisure context. Accordingly, this group of leisure users is seen as a natural focus.

Section 3.2.5 describes how the virtual museum visitor is elusive and harder to characterise than the physical visitor. This is especially the case in the present study, as it aims at going beyond web surveys and log analysis. However, direct observation of virtual visitors' information behaviour is complex, since it is typically not possible to observe virtual visitors in their natural context of use, typically their home or office

(Cunliffe et al., 2001, p. 237). Therefore the present study carried out a user study in a controlled setting (see section 5.4.3) combined with follow-up interviews (see section 5.4.4) to provide rich qualitative data to complement the quantitative data from the web questionnaire survey. Real virtual museum visitors were recruited as participants through the web questionnaire. This approach is chosen instead of using proxy-users or asking physical museum visitors to *act* as if they were virtual visitors, which can be a methodological issue since they might represent different needs and characteristics (Cunliffe et al., 2001, p. 235). A methodologically drawback of the chosen approach is, that both the web survey and the user study build on a self-selected sample. A possible bias in a self-selected sample is "…whether the group that would not participate differs in some manner from the group that would participate (Zhang, 2000, p. 59). Further possible biases of self-selected samples are multiple responses from the same respondents and that only some people are comfortable with the web survey format (Zhang, 2000, p. 59). The overall results may over-represent these respondents. Despite these possible biases, a self-selected sample method was chosen as it is seen as the only possible way to reach the group of elusive virtual museum visitors. Given the possible biases, the case study does not claim representativeness.

The following three sub-sections outline the data collection methods applied in relation to virtual museum visitors.

5.4.1 Analysis and coding of written enquiries

Written enquiries received at the museum in 2005 from the general public were analysed. Even though the written enquiries, both e-mail and letters, not necessarily reflects information needs of virtual museum visitors, the data were easy accessible and provided initial information on types of information needs of museum visitors in general, specificity of terminology used and they served as inspiration in the following research design.

The museum received a total of 396 written enquiries in 2005. First, enquiries concerned with the museum's facilities, ticketing etc. were filtered out. Similarly, enquiries not related to the museums collections or subject field were filtered out. These 'misplaced' enquiries were identified by relating all enquiries to the museum's answers. Typically, the museum would direct the enquirer to another relevant museum, archive or website etc. After that, a total of 179 object and collection related enquiries (containing 226 requests) remained for analyses. The 226 requests were coded and categorised according to Ingwersen and Järvelin's matrix of eight intrinsic types of information needs (Table 7.4). The results are presented in Section 7.1.2 on museum visitors' leisure tasks and derived information needs.

Finally, analysis of the written enquiries served as input and inspiration in the formulation of (1) answer categories in the web questionnaire survey (see section 5.4.2.1), and (2) simulated search tasks and accompanying cover stories used in the first part of the user study (see section 5.4.3.1).

5.4.2 Web questionnaire survey

The purpose of the questionnaire is twofold. Firstly, to provide initial information about virtual museum visitors' areas of interests, information needs, preferred data elements, as well as demographic data. The second purpose is to recruit participants to a succeeding user study. Appendix 4 shows an English version of the questionnaire. The online version of the questionnaire (in Danish) can be found by following this link: http://kalus3.kalus.dk/a?e=kMEFvSwTHsD9.

A main advantage of using a web questionnaire is its ability to reach many geographically dispersed respondents with relatively few resources. E-mail has been one of the most frequently used Internet tools for survey research because of its convenience combined with the possibility of directing a survey to a specific target group (Zhang, 2000). In the present study, a web questionnaire survey is chosen as data collection method in order to reach the intangible group of virtual museum visitors of The Military Museum's online catalogue. It is a target group that we know little about and have no contact information on. Similar to other impersonalised survey requests, e.g., mail or e-mail questionnaires, web questionnaires often suffer from low response rates and in some cases, it is even difficult to determine the size of the target population and thus to estimate the response rate (Zhang, 2000). This is also the case in the present study (see section 5.4.2.2). Therefore the initial information obtained in the web questionnaire cannot stand alone but is validated and extended with more aspects and details in the succeeding user study.

5.4.2.1 Design of the web questionnaire survey

The questionnaire primarily consists of closed questions in combination with a few open-ended questions. Closed or pre-coded questions are advantageous for several reasons. It is easier for a respondent to select from a pre-set range of possible answers, than describing with his or her own words. It is timesaving in the later analysis phase, as the researcher only deals with predetermined categories. Finally, it ensures that the data obtained can be measured and compared on a common dimension (Buckingham & Saunders, 2004, p. 74). The main disadvantage of pre-coded questions is that respondents are not allowed to go outside the pre-defined categories and thus much variety is lost. The present study tries to meet the disadvantage of pre-defined categories by giving respondents the possibility to add their own comments on blank lines. This possibility is given in relation to questions, where the researcher cannot be sure that the pre-coded categories are fully exhaustive (questions number 2, 3, 4, 5, 6, 8, and 10).

Following the recommendations by Buckingham and Saunders (2004), the many pre-coded categories have been chosen of two reasons. Firstly, the aim of the questionnaire was to provide an initial overview of the virtual museum visitors. Secondly, in order to improve the response rate of self-completed questionnaires it is necessary to keep it short, with a clear layout and with many pre-coded answers (Buckingham & Saunders, 2004, pp. 69-70).

The web questionnaire was constructed using the questionnaire software, Kalus. Respondents' answers are automatically added to a database and can easily be extracted into Excel or SPSS for subsequent statistical analysis, which is a further advantage of web questionnaires. The questionnaire consists of a total of sixteen questions, but as two contingency questions are included (questions number 2 and 14) the maximum number of questions to be answered by a respondent is fourteen. The Kalus questionnaire software supports the use of contingency questions, where respondents must go to different questions depending on how they have answered earlier ones, by automatically taking the respondent to the subsequent question. Again, keeping the questionnaire simple and easy to complete is important to improve the response rate.

The web questionnaire contains the following group of questions:

- Context of virtual museum visit:
    - How often have you visited The Military Museum's website (question number 1).
    - Context of visit (question 2). Question 2 is a contingency question and depending on the respondent's answer, he was directed to either question 3 (in what area do you work), question 4 (describe your hobby / interest area), or question 5 (indicate level of your study). *Only respondents*

visiting the web site in a leisure or hobby context were directed to the remaining questions.

- Hobby: use of information channels in relation to this specific hobby and knowledge level (questions number 6 and 7).
- Virtual museum visit: purpose of visit, outcome of visit, and what information on museum artefact do you find useful (questions number 8, 9, and 10).
- Demographics: level of education, occupation, age, and sex (questions number 11, 12, and 13).
- Invitation to participate in user study. The respondents were informed that the web survey was part of a larger study. They were asked whether they were interested in participating in a succeeding user study. If they agreed, they were asked to submit their name and e-mail address in order to receive further information (questions number 14 and 15).

Before publishing the questionnaire it was pre-tested among seven colleagues. Based on their feedback small changes in question wording were made to improve understanding and two additional answer categories were added to question number six (answer category ‘documentary programs on TV or DVD’ and ‘blogs on the internet’). After the pre-test, a pilot study was conducted with two pilot-participants. They tested both the web questionnaire and the design of the succeeding user study (see also 5.4.3 and 5.4.4). Each of the two pilot tests lasted approximately 1½ hours. In relation to the web questionnaire, only a single additional answer category was added based on the pilot test (question number four, answer category ‘military miniaturism’ which covers model building of military ships, vehicles, figures and equipment).

5.4.2.2 Publishing and response rates

The web questionnaire survey was published by providing a link from the survey to two different places at The Military Museum’s website. As the target group of the questionnaire is the users of the museum’s online catalogue, the two links appeared on the main site of the online catalogue (www.thm-online.dk) and on a site providing access to different content online, like earlier exhibitions, respectively. In line with Goldman and Schaller (2004), we hoped to reach respondents who visited the site for a content-based reason, excluding the large numbers of people who visit a virtual museum for the opening hours and admissions to the physical museum. Analysis of survey data shows that compared with other surveys of virtual museum visitors (e.g., Thomas & Carey, 2005) few respondents (21.5%) indicate ‘plan a visit to the museum’ as purpose of visiting the Military Museum's web site. Instead, the most frequent purposes of visits relate to the collections and objects (see Table 7.5, p. 162), which shows that the web survey succeeded in mainly reaching the intended respondents. The web survey was active in a two months period covering from the 11th of February to the 14th of April 2008.

As mentioned above, web questionnaire surveys often suffer from low response rates. The following actions were taken in the present study to help increase the response rate:

- Publishing and invitations:
    - Invitation to participate and link the web to survey was published on The Military Museum's web site.
    - Survey request to newsletter: a survey request was sent to a Danish military history newsgroup, ArmaDania. By courtesy of the newsgroup editor, the survey request was included in the editor's weekly newsletter on the 24th of February 2008. The editor included a kindly reminder in the newsletter two weeks later.
    - An invitation to participate was published in a Danish (print) journal on military history (Våbenhistorisk Tidsskrift, January, 2008). The invitation is depicted in appendix 5.
- Other:
    - Sponsorship: according to Frankfort-Nachmias and Nachmias (2000, p. 208) the sponsorship of a questionnaire has a significant effect on respondents, often motivating them to complete it. As The Military Museum is well-known among the target population, both the logo of The Military Museum and The Royal School of Library and Information Science, was printed on the survey. Similarly, both institution names were mentioned in the survey requests.
    - Incentive: by completing the questionnaire, a respondent could win a small incentive (a 1 GB memory stick and a season ticket to the museum). 15 respondents participated in the drawing lots.

The response rate is difficult to calculate in this web questionnaire survey because it is tricky to determine the size of the target population. That is, the users of The Military Museum's online catalogue. An estimation of a response rate, however, can be calculated based on visitor numbers from Google analytics software. According to

Google analytics, 1,897 unique visitors visited the online catalogue during the two month period. As 153 responded to the web questionnaire, it results in an estimated response rate of 8%. This is a quite low response rate, which is an often discussed disadvantage of web surveys (e.g., Zhang, 2000). Another disadvantage of web surveys is the risk of receiving multiple responses from the same respondent (Zhang, 2000, p. 59). This risk is considered low in the present survey because almost half of the questionnaire respondents (58 out of 127) stated their name and e-mail address in the questionnaire in order to receive further information about the succeeding user study. No double responses were identified.

Based on the assumption, that there is an overlap between visitors to the physical and virtual museum, the present researcher carried out a number of *personal interviews* with museum visitors in The Military Museum's exhibition areas. It was an attempt to increase the number of survey respondents and recruit participants to the succeeding user study. The personal interviews took place three days during February 2008 and the same questionnaire was used as in the web survey. All together 107 visitors were contacted. 61 visitors out of the 107 visitors had never used the Military Museum's website. Accordingly, only the remaining 44 visitors are counted as respondents. A major part (88.6%) of the 44 respondents had used the museums website in relation to basic information like ticketing, opening hours, etc. Only 5 respondents (11.4%) had used the online catalogue to look for content or artefact related information in connection with an interest area or hobby. Table 5.1 shows the number of respondents of both the online and personal interview survey as well as the number of recruited participants to the user study. Of the total number of hobbyist (132) only two were female and none of the participants in the user study were female. Further, table 5.1 shows that none of the personal interviewed respondents agreed to participate in the user study. All in all the personal interviews were very time consuming, resulted in very few target group respondents and recruited no participants to the user study. Therefore the personal interviews were stopped after three days. Instead, 24 participants were recruited through the web questionnaire survey, which will be further explained in section 5.4.3.

Table 5.1: Number of respondents in the online and personal interview survey

Survey of virtual museum visitors	Total number of respondents	Number of hobbyist (invited to participate in the user study)	Number of hobbyists interested in participating in user study	Number of participants in the user study
Web survey on the museums web site	153	127	58	24
Personal interview survey at the physical museum	44*	5	0	0
Total	197	132	58	24

* Altogether 107 visitors were contacted in the personal interview survey in the physical museum. 61 out of the 107 visitors had never used The Military Museum's website. Accordingly, only the remaining 44 visitors are counted as respondents.

5.4.2.3 Analysis of collected data

The web questionnaire survey generated primarily quantitative data as well as a few qualitative data. The qualitative data was limited to respondents' comments in the 'other – please explain' fields in the questionnaire. In general, respondents' comments were kept very short (a few words) giving concrete examples of, e.g., information sources, interest areas, and data elements. Respondents' comments were used by the present researcher as additional background knowledge when conducting the interviews in the user study.

The quantitative data were exported from the questionnaire software, Kalus, to the statistical software, SPSS 16.0, for further analysis. First, basic descriptive statistics was used to summarise and describe the data set. Next, probability statistics was applied. As explained above the web survey is based on a self-selected sample. Therefore the selection of respondents is not based on a chance, which means that, strictly speaking, probability statistics is not appropriate for making estimates from the collected data (Buckingham & Saunders, 2004, p. 122). Having said that, probability statistics was applied in order to *explore* the quantitative web questionnaire data further and thus support the primarily qualitative data analysis.

Chi-square tests were applied in order to explore possible associations, since the chi-square test “[…] is an inferential statistical test that is used to examine relationships between two variables with nominal or ordinal data” (Vaughan, 2001, p. 75). Thus, it is appropriate for testing for associations between variables in the collected data from the web questionnaire. The significance level was set to 0.05. Associations were tested between three independent variables (age, knowledge level and type of hobby) and relevant dependent variables (see Section 7.2.1 and 7.3.1). Sex was not used as an independent variable as there were only two female respondents. The first two independent variables (age and knowledge level) are self-explanatory; however, the independent variable ‘type of hobby’ is explained in the following.

When the 24 user study participants’ hobbies were categorised according to Stebbins (1994; 2007) hobby types, a clear and interesting distinction between two main groups of hobbyists emerged (see also section 7.1). *Collectors* formed the largest group and *liberal arts enthusiasts* of defence and military history the other main group. However, since a direct link between survey respondents’ interest areas and Stebbins’s hobby types could not be established, cluster analysis (k-means) was used in order to apply the distinction between collectors and liberal arts enthusiasts to the web questionnaire data. Respondents were grouped into two clusters based on their responses to the two most often indicated interest areas in questionnaire question number four (‘a specific type of artefact’ and ‘defence and military history in general’). The qualitative interviews had shown that these two interest areas were particularly expressive as to classify participants into the two hobby types. The clusters were named ‘collectors’ (93 respondents) and ‘liberal arts enthusiasts’ (39 respondents). A subsequent manual check showed agreement between the current researcher categorization and the categorization based on the cluster analysis with regard to 20 out of the 24 user study participants.

5.4.3 User study part I: Simulated search task situations

Both parts I and II of the user study investigate virtual museum visitors’ information seeking behaviour. Part I focuses on the part of information seeking that relates to participants’ searching behaviour by studying *simulated search task* situations. Hence, part I of the user study relates to research question 2.d on characteristics of searching behaviour. Part II investigates participants’ *real* leisure tasks and derived information needs in a hobby context. Part II contributes to research question 2.a, 2.b and 2.c. The methodological setup of the user study is described in the following, but first the recruitment of participants to the user study is described.

In the web questionnaire survey 58 respondents indicated that they were potentially interested in participating in the user study (see Table 5.1). An e-mail invitation with further details about the user study was sent to these potential participants (see e-mail invitation in appendix 6). The invitation briefly described the user study and that it required a personal meeting of approximately 1½ hours duration at The Military Museum in Copenhagen. An incentive, a 1 GB memory stick with a special selection of military photos and a season ticket to The Military Museum, was offered to all participants. Out of the 58 potential participants, 24 respondents agreed to participate in the user study (part I and II). Respondents' main reason for not participating was geographical distance. Others did not reply to the e-mail invitation. The 24 participants were all men and their age ranged from 32 to 72, with an average of 49. Five were retired. The majority (20) of the user study sessions took place at an office at The Military Museum's administration. Two sessions took place at participants' private homes and two were conducted at participants' place of work. The 24 user study sessions were conducted from the 7th of February to the 24th of April 2008.

5.4.3.1 Simulated search tasks situations

The first part of the user study explored how virtual museum visitors interact with an online museum catalogue. Building on Borlund's (2000b) evaluation framework for interactive information retrieval systems, simulated search tasks situations were conducted in order to gain knowledge of users' searching behaviour. Focus was on 1) which access points / data elements are preferred in a searchable record and for what purpose (research question 2.b), and 2) how different task types affect search attributes and search strategies (research question 2.d).

Borlund's proposed experimental setting for evaluation of interactive IR systems consists of three basic components:

1. The involvement of potential users as test persons;
2. The application of dynamic and individual information needs; and
3. The employment of multidimensional and dynamic relevance judgements (Borlund, 2000b, p. 72).

The present study takes the experimental setting a step further as *real* users, not just potential users, are used as test persons. This step allow us to gain knowledge of the users' information seeking context including real information needs, motivation etc. (see 5.4.4). The dynamic and individual information needs were triggered by simulated search task situations. These search task scenarios were intended to provide the searcher with background motivation to the search and sufficient contextual detail to decide on the relevance of the viewed *collection records*. In this way users were encouraged to threat the search task as a personal task, searching as though the task was their own (Borlund, 2000b). This experimental setting allowed a comparison between different people searching on the same tasks. Thus facilitating a relatively controlled evaluation environment and at the same time maintaining a test situation as close as possible to actual information seeking.

Four simulated search tasks were designed inspired by real life information needs reflected in the written enquiries from the public to the museum *and* based on Borlund's (2000b) findings on what constitutes a motivating and engaging simulated work task. The four search tasks are shown in Figure 5.5 and they simulate the following different types of information needs:

- Task A reflects an well-defined topical information need. Participants were asked to decide on the use of a purchased powder horn based on an enclosed photograph of the 'purchased' powder horn.
- Task B reflects a data element search. Participants were asked to identify names of gun makers from the town of Odense and information on their weapons.
- Task C reflects an ill-defined topical information need. It is a broad and semantically open task. Participants were asked to find information related to the 2nd world war.
- Task D reflects a combined known item and data element search task. This task specifically asked the participants to find information on a Colt Navy revolver seen in the museum's exhibition (known item) and to verify whether the museum has more Colt Navy revolvers (known data element).

The search tasks were given in permuted order in order to avoid any effect the order might have on the result. The scenarios outlined in the four tasks simulate different types of tasks. Task A is a situational task (flee market). Task B is a work task (writing an article). Finally, in task C and D it is an interest task that triggers the simulated information need. Across types of tasks, the most important aspect is that the task can motivate the test person and provide a context for test persons' individual information need interpretation and assessment of search results.

Task A: Powder horn

You went to the flea market last weekend and by coincidence you found an old powder horn. You bought the powder horn and was told, that it had been used in connection with hunting. However, one of your friends is certain it was used in the military. Now you are looking for different types of powder horns to try to decide on its use. (A photograph of the 'purchased' powder horn was shown to the use study participant).

Task B: Gun makers

In your free time you do some research on the local history of your home town, Odense. In connection with the town's anniversary you plan to publish a small article on the town's industrial history. Therefore you are now doing some research on gun makers from your home town. You are interested in finding names of gun makers from Odense and maybe information on the weapons they produced.

Task C: The Second World War

You are interested in Danish defence history relating to the Second World War. You visited the Military Museum's exhibitions but you did not find as much information about the Second World War as you had expected. Therefore you are looking for additional information on their web site. You are interested in both objects, photographs, background information etc.

Task D: Colt navy

You visited The Military Museum a couple of weeks ago because you are interested in American western history. You saw the exhibition on hand weapons, and you are pretty sure you found a Colt Navy revolver. Now you are interested in finding more information on this type of weapon and whether the Museum has more Colt revolvers.

Figure 5.5: The four simulated search tasks.

The test persons participated in the study one by one and the simulated search task situations consisted of the following steps:

1. Introduction to the study (including purpose of study and explanation of the participant's part in the study);

2. Short demo of the online museum catalogue;
3. Execution of four search tasks;
4. Retrospective talk-aloud sessions after the participants had completed all four search tasks (see section 5.4.3.2).

In line with other studies using simulated search task situations (Borlund, 2000b; Tombros, Ruthven, & Jose, 2005), participants were instructed to retrieve as many useful documents as it would take to satisfy their information need. The decision on what constituted relevant information, and whether or not the search task had been completed, was made by the searcher. Participants were encouraged to search for information in any way they found useful or natural, and the search sessions were carried out with no time limitation. The only two restrictions placed were that they could not ask for further information or recommendations and they could only search the Military Museum's online catalogue. The author was present in the room during the study. Start and stop time for each of the four tasks was noted down in a combined observation and questioning protocol (appendix 7) together with initial observations of the present researcher. However, most information from the search sessions was extracted later through the analysis of the recorded sessions.

During the search sessions, desktop activities including mouse movements were recorded using the Morae software tool version 2.0 (Morae is a product of Techsmith Corporation, http://www.techsmith.com). Also, both the simulated search task situations and the succeeding retrospective think-aloud sessions were voice recorded. The Morae software tool was installed on a lap-top computer. In this way it was possible to conduct the user studies in various settings – in the museum (20 sessions) or at participants' homes (2) or workplace (2) – as stated above. The recordings were used in the retrospective talk-aloud sessions described in the following section.

5.4.3.2 Retrospective talk-aloud sessions

A retrospective talk-aloud session took place immediately after a participant completed the simulated search session. The purpose of the retrospective process was to help obtain verbalised, explanatory information on the search process. The term talk-aloud is here preferred over the term think-aloud. Talking aloud is a variation of thinking aloud. The former is easier because it does not require training sessions prior to the experiments and requires less attention than thinking aloud (Ingwersen, 1982).

In *retrospective* talk-aloud protocol sessions, participants perform their tasks silently and afterwards comment on their work on the basis of a recording of their performance. A similar and more common used method is the *concurrent* think-aloud protocol (or again talk-aloud), where participants verbalise their thoughts while task performing (Haak, de Jong, & Schellens, 2004; Ingwersen, 1982). Two recent studies compare the methods of concurrent and retrospective think-aloud protocols (Haak, de Jong, & Schellens, 2003; 2004). They find the two evaluation methods to be very much comparable, but with some differences. A practical drawback of the retrospective think-aloud protocol is, that it is more time-consuming than the concurrent think-aloud protocol, because it requires double the test time to allow the participants to watch and comment on their recorded performance. In the present study this practical drawback is considered of minor importance. The retrospective talk-aloud method is chosen because it results in a better completeness of participants' verbalisations: "…while the CTA [concurrent think-aloud] method resulted in significantly more problems detected by means of observation only, the RTA [retrospective think-aloud] method proved more fruitful in revealing problems that could only be detected by means of verbalisation" (Haak et al., 2004, p. 1168). According to Haak et al. (Haak et al., 2003, p. 349) a possible explanation to this is that the double cognitive workload of the tasks combined with the extra task of thinking (or talking) aloud appears to have a negative effect on participants' verbalisations. As the purpose of the talk-aloud method in the present study was to obtain additional verbalised information on the search process, the retrospective method was chosen.

Validity of retrospective talk-aloud protocols depend much on the stimuli participants get to help them recall their thoughts (Haak et al., 2003). Therefore participants in the present study were immediately after the completion of search tasks exposed to a recording of the search process they went through, as recommended by Haak et al. (2003). The recordings show screen activities including mouse movements.

During the retrospective talk-aloud sessions participants were asked to comment and explain on their search sessions in order to obtain verbalised, explanatory information on the search process. When necessary the present researcher asked neutral questions on the following two aspects (the questions are shown in the combined observation and questioning protocol in appendix 7):

- Querying / browsing
    - Aim of querying and/or browsing
    - Choice of access points
- Scanning / reading content

- What data elements are used in this search task and for what purpose?
- Does the user miss any data elements?
- From the result list, how does the user decide which collection records to open and view?

Immediately after the first part of the user study was finished, qualitative follow-up interviews were conducted with all 24 participants. This second part of the user study aimed at elaborating the quantitative data from the questionnaires and gaining insight into the leisure context of the 24 participants' information seeking behaviour. The second part of the user study is described in the following section 5.4.4. Where the first part of the user study was based on *simulated* work task situations, the second part of the user study, described in the following section, focused on *real life* leisure task situations.

5.4.4 User study part II: Qualitative follow-up interviews

The purpose of the follow-up interviews with the 24 participants was to obtain rich, qualitative data to add to the characteristic of virtual museum visitors' information seeking behaviour provided by data from the web questionnaire survey. Applying methodological recommendations by, e.g., Wang (1999), the follow-up interviews were designed to validate and elaborate the quantitative data obtained in the web questionnaire survey. The interviews to place immediately after the retrospective talk-aloud sessions. They were voice-recorded and lasted in average about 30 minutes. The design of the interview guide and process of subsequent analysis of interview data will be covered in the following two sections.

5.4.4.1 Design of interview guide

To a large extent the follow-up interviews covered the same areas as the questionnaire survey, and the interviews were guided by the content of the filled in questionnaires. The interviews provided elaborate answers, illustrative examples and they allowed participants to use their own wording, which is important if one wishes to collect data on cognitive perceptions. Besides covering the areas of the questionnaire, also more broad questions were asked in the interviews, as very little is known about why users seek digital museum resources (Marty, 2007) or how they use and integrate digital museum resources into their everyday lives. Two earlier studies (Hartel, 2003; Yakel, 2004) addressing information seeking behaviour of non-professionals and drawing on the ELIS framework by Savolainen (1995), inspired the design of the interview guide in relation to including these more broader questions.

Similar to the design of interviews with museum professionals (section 5.3); the critical incident technique (Flanagan, 1954) was used to trigger the participant to recall and explain his cognitive perceptions at the time of the event. Here, the critical incident was defined as the trigger of an information need or interest resulting in a virtual visit to the Military Museum's online catalogue. The interview focused mainly on *the specific* and *recent* incident where participants also filled in the web questionnaire. By focusing on a specific and recent incident we try to minimize a retrospective bias, reflecting participants' limited ability to recall an incident and accordingly a faulty reconstruction of the phenomena of interest (Bolger, Davis, & Rafaeli, 2003, p. 585). This said, attention was also given to other incidents mentioned by interviewees in order to cover as broad, complex and diverse incidents as possible.

The interviews were structured according to the interview guide shown in appendix 7. The interview guide consists of the following four parts, and like the online questionnaire survey the interviews contributed to research questions 2a-2d:

1. Characteristic of hobby/area of interest.
2. Critical incident.
3. Information sources and channels
4. Information sharing and use.

The interviews together with the simulated search task situations formed the user study of virtual museum visitors' information seeking behaviour. The following section discusses how data from both parts of the user study was analysed.

5.4.4.2 Analysis of collected data from user study part I and II

The user study provided logging data from the search sessions and verbal data from the retrospective talk-aloud sessions and interviews. The outcome of the logging was a video clip from Morae for each of the 24 search sessions. Each search session covered four search tasks. The recorded video clips were subsequently examined and information was extracted in relation to various search attributes. The extracted information was written in the observation protocols. By comparing the various search attributes we hoped to verify how different task types affect search attributes and search strategies. Search tasks were coded on the following quantitative search attributes dimensions[34]:

- Average time per search task
- Number of viewed hits in the result list
- Number of records viewed
- Number of large photos viewed
- Number of times the zoom function was used
- Number of scanned registration material viewed
- Number of search iterations

A one-way ANOVA test (level of significance of 0.05) was carried out according to the following overall hypotheses in order to analyze differences among the four search tasks in relation to the above listed search attributes:

Ho: no difference exists between the different types of search tasks

Ha: difference exists between the different types of search tasks

ANOVA is an inferential statistical test used to determine if the differences among three or more sample means are statistically significant (Vaughan, 2001, p. 125). The test requires data of ratio or interval type. This requirement is met since the present data is of ratio type. From the ANOVA result we cannot tell whether one task differs from the other two, or all three tasks are different. Therefore a post hoc multiple comparisons test (the LSD test) was used to examine patterns of differences. Like the web questionnaire, also recruitment of participants to the user study is based on self-selected sample. Therefore, like explained in section 5.4.2.3, the statistics was applied in order to *explore the* quantitative data and support the primarily qualitative data analysis. Finally, presence or absence of different search strategies (variants of browsing versus searching) was extracted. Section 7.4.1 shows that clear distinctions were identified between the four tasks. Accordingly, no statistical analysis was applied.

User study participants' *verbal* comments during the retrospective talk-aloud sessions were also analysed. The present researcher's comments on the search sessions and relevant quotes were added to the observation protocols. The observation protocols together with short resumes (including relevant quotes) of the qualitative follow-up

[34] No formal relevance judgements were captured as it is not an aim to analyse search performance.

interviews were imported to the ATLAS.ti qualitative data analysis software. A coding scheme was developed with the four research questions related to virtual museum visitors as a starting point. Based on an inductive content analysis approach and several iterations, the extensive text material was coded. See section 5.3.2.3 for methodical considerations on using a content analysis approach and the ATLAS.ti software.

5.5 Methodical reflections

This chapter has outlined the primarily qualitative research design and methodical considerations of the present case study. According to Wang it is "…inherited in qualitative research that verbal data collected in natural settings are rich, detailed and insightful, meanwhile, unsystematic and incomplete (Wang, 1997, p. 315) Therefore results cannot be generalized; rather they should be taken as exploratory, suggestive, and case-based and subject to further study. This also holds for the present case study especially in relation to the museum professionals. In relation to virtual museum visitors, on the other hand, a triangulation of research methods was applied including both qualitative and quantitative data collection methods. The methods were complementary and, for instance, patterns identified in the interview were used as input for cluster analysis of quantitative questionnaire data.

As mentioned earlier interviews were conducted with all museum curators at the Military Museum at the time of study. However, the question remains whether ten interviews can provide a coherent characteristic of museum curators work tasks and information seeking behaviour. In that respect, it is important to note that as the process of interviewing progressed a point of saturation was experienced. That is, a point of saturation where a new interview did not add much more explanation to the phenomenon being studied (Strauss & Corbin, 1998, pp. 212-215). In addition, earlier research (Park, 1993; Schamber, 2000) shows that ten respondents are enough to generate reliable results in explorative user studies of cognitive perceptions.

Simulated search task situations (Borlund, 2000b) were applied as one of the research tools to collect data on virtual museum visitors' searching behaviour. The data collection method contributed to investigate how different task types affect search attributes and search strategies (see section 7.4). However, the analysis indicates that some aspects of *exploratory* searching behaviour are difficult to capture by using simulated search task situations. For instance, several participants transformed the semantically open and ill-defined search task to a known item task – feeling the former as easer. Likewise, the very assignment of a task contradicts undirected browsing (Marchionini, 1995) which is an expected part of exploratory searching.

Use of the critical incident technique in the qualitative follow-up interviews likewise indicated difficulties in relation to capturing information on the highly exploratory information needs (see section 7.1.3). This limitation in relation to the critical incident technique is also identified by Urquhart: “The CIT [critical incident technique] is less equipped to explore those situations in which there was no decision to act, or where the user was unaware of the information need” (2003, p. 71).

6 Results regarding professional museum curators

The present study examines characteristics of information seeking from a work task perspective in order to connect the work/leisure task (and derived information seeking task) with the search process and analyse how they interact. This chapter presents the results regarding museum curators' information seeking behaviour. Results regarding virtual museum visitors are covered in chapter 7. The following research questions are answered and discussed with the objective to explore and gain insight into how resource descriptions of museum artefacts are searched for and used in the information seeking process of museum curators:

What characterises information seeking behaviour of *museum curators*? As to:

- 1.a Their object-related work tasks and derived information needs?;
- 1.b What are the relationships between types of work tasks and types of information needed in those tasks?; and
- 1.c What information sources are used in what kind of work tasks?

The main contribution of this chapter is an in-depth exploration of the work tasks, information needs, and challenges that museum curators face when they are searching for information. Focus is on *object-related* information seeking behaviour, as it is the *dual interaction* between museum objects including their documentation *and* other information sources that distinguishes museums experts' information seeking behaviour from related experts within the humanities (see section 4.3.1).

The following three sections (6.1-6.3) each cover a research question.

6.1 Museum curators' work tasks and derived information needs

As outlined in chapter 4, work tasks serve as a common starting point to scrutinize individual actor's information seeking behaviour during task performance. Accordingly, this section answers research question 1.a concerning what characterises information seeking behaviour of museum curators as to their object-related work tasks and derived information needs.

6.1.1 Identification of four main object-related work task

In the context of information seeking, the present study is interested in museum curators' object-related work tasks. Based on the interviews with the ten museum curators, four main types of object-related work tasks were identified in the case museum. In addition, a number of other non-object-related tasks like administration, marketing, and other visitor related activities were identified. They are not considered further in the present study.

The four object-related work tasks and their sub-task are outlined in the following:

1. *Collection management* relates to the case museum's obligation to collect and preserve cultural heritage objects related to Danish defence and military history. The task covers a number of sub-tasks in relation to object handling and managing of the collections' documentation. It includes registration of new objects, update of existing records, digitization of records for both internal and external use (e.g., the online museum catalogue), research in connection with object acquisition (Christensen, 2006) and, using Orna and Pettitt's (1998, p. 29) terminology, adding information to the museum's collections, whether by identifying them more precisely or by discerning more accurately their relationship with human society.

2. *Answering of inquiries to the museum.* The Military Museum has a formal responsibility to answer inquiries from the public or other cultural heritage institutions about objects in their collections. In comparison with the three other work tasks, the museum curators describe how answering of inquiries takes up a small percentage of their time. Nevertheless, this specific work task is included here because it is frequent occurring, although not time consuming, and highly object-related.

3. *Exhibition planning and design* relates to the museum's obligation to exhibit and present objects related to Danish defence and military history. It includes sub-tasks of planning, research, object selection, documentation of objects, and presentation of research. Depending on the scale of the specific exhibition, exhibition planning and design may cover from 3-4 months to several years. The time frame of the new permanent exhibition at the case museum is six years.

4. *Research* is conducted as part of both collection management and exhibition planning, however, research is also viewed as an individual work task. These

> research activities often relate to defence and military history at a more abstract level and are thus not necessarily object-related. For instance, curator 6 conducts biographical research on a naval officer from the eighteenth century and curator 9 describes a research project on Danish defence history related to 1945-1973. On the other hand, curator 2's research on purchase of weapons during the reign of the Danish King Christian the Fourth is an example of a research project partly building on object-related data (see critical incident number 15 in Table 6.2 below).

With the four main object-related work tasks as a starting point, the following section outlines information needs of museum curators extracted from the critical incidents.

6.1.2 Work tasks and derived information needs extracted from critical incidents

In the interviews, the museum curators were asked to describe their main work tasks and to give examples of recent situations that prompted an object-related information need. From the examples, one or two situations or critical incidents were selected to form the primary focus of the remaining interview. In total 15 critical incidents were selected based on nine[35] museum curators' descriptions of work tasks and derived information needs. Table 6.1 shows the distribution of tasks and critical incidents related to the four main tasks. To give an example, six out of the ten museum curators are engaged in collection management work tasks. Out of the six curators, three curators supply a total of four critical incidents related to collection management (see second row in table Table 6.1).

[35] In total all ten museum curators at the case museum were interviewed. However, although the interview with the museum director added to our general understanding of curators' work tasks, this specific interview only marginally covered work tasks including object-related information seeking aspects and no critical incidents were identified. Therefore the 15 critical incidents are derived from only nine interviews. See also section 5.3.2.2.

Table 6.1 Distribution of tasks and critical incidents related to the four main object-related work tasks

Type of object-related work task:	Number curators undertaking task (N = 10)	Number of curators supplying critical incidents	Number of critical incidents related to task
Collection management	6	3	4
Answering of inquiries	5	3	3
Exhibition planning & design	6	4	7
Research	5	1	1

In the following, the 15 critical incidents are described and analysed in order to provide a characteristic of the associated work tasks and derived information needs. An overview of the object-related work tasks and derived information needs extracted from the critical incidents are shown in Table 6.2.

Each critical incident is categorised according to task type, a priori determinability, and type of information need. The framework on work task complexity developed by Byström and Järvelin (1995) has been used to identify the a priori determinability of task process and outcome. In line with later studies (Byström, 2002; Lykke Nielsen, 2002) building on the task complexity framework, the present study applies only three levels of perceived a priori determinability due to the relatively small sample. Task complexity is considered in terms of *perceived* a priori determinability of information inputs, processing, and outputs (Byström & Järvelin, 1995; Byström, 2002). A low degree of a priori determinability indicates a complex work task where the outcome and information requirements cannot be characterised in advance. A high degree of a priori determinability indicates a simple task with a high degree of repetitiveness which includes little case-based consideration. The a priori determinability of each task was identified by analysis of interviewees' description of critical incidents. That is, by considering interviewees' description of the underlying work task and information need(s) combined with how interviewees' described the complexity level of the task (questions 5 and 6 in the interview guide, see appendix 3).

Table 6.2 Overview of museum curators' work tasks and derived information needs

Type of task and sub-task (critical incident number)		**Curators' information need extracted from critical incidents descriptions**
Collection management:		
1	Object acquisition	The museum has been offered a large collection of mainly edged weapons from before 1928. Information is needed to support typological classification of the objects in order to decide which objects to incorporate into the museum's collections.
2	Select objects for restoration	Find information to help select which colours to send to the conservator.
3	Add information to holdings	Relate and study different internal sources to add to the provenience information on objects in the collection of hand weapons.
4	Prepare object acquisition	Study background information on Danish UN-forces in Bosnia and possibly related objects in collections.
Answering of inquiries		
5	Find object information and specific objects	Find components related to the Danish military uniform model 1903. E.g., does the museum have a specific full dress uniform?
6	Find information and photo	Find information on and a photograph of a specific military vessel.
7	Verify physical measurements	Physical measurements on two-handed swords in the collection.
Exhibition planning and design:		
8	Object selection and documentation of objects	Verification and further study of information on two Danish resistance armbands and two military helmets. Information used for object selection in relation to planning the section on the Second World War in the new permanent collection on War & Man.
9	Object selection and documentation of object	Research on provenience information on a specific armour from around 1500.
10	Object selection and presentation of information on a special collection	Verify and research provenience information and associated, historical information on about 40 military colours related to a specific battle in 1676.
11	Object selection and presentation of information	Find objects illustrating means of military communication. Both representative objects and objects illustrating the development from signal flags to computers.
12	Object selection	Find information to help verify and relate different uniform parts within a special collection. Find provenience information.
13	Object selection	Information to provide overview and support selection of objects to a special exhibition on the Danish military in the 1700 with focus on military uniforms.
14	Object selection	Find and explore provenience information on a Spitfire aircraft in the museum's collection.
Research		
15	Research on purchase of weapons during the reign of the Danish King Christian the Forth	Identify weapons in the museum's collections related to the time period of the Danish King Christian the Fourth.

Curators' information needs are also categorised according to Ingwersen and Järvelin's (2005, pp. 292-293) typology of information needs (see also 4.4.1). The categorisation of the 15 critical incidents is shown in Table 6.3 (see column 1, 2, and 4). In order to provide a full overview of the studied attributes, the type of information needed and main types of information sources and channels used are also shown in Table 6.3. Type of information needed (column 5) is discussed in section 6.2 and types of information sources and channels used (column 6 and 7) are discussed in section 6.3.

Critical incidents number 1-4 relate to *collection management*. The first three are often occurring work tasks primarily relying on the museum's own documentation as source of information. In the first critical incident, for example, the Military Museum has been offered a large collection of mainly edged weapons from before 1928. Curator 4 describes how information is needed to support typological classification of this large group of objects. It is considered a known item information need, as curator 4[36] knows the object types but occasionally needs to check details or distinguish between closely related variations of the same object type. Likewise, the work tasks in critical incidents number two and three are described as routine tasks reflecting a high degree of a priori determinability.

In contrast, critical incident four reflects a *collection management* task of low a priori determinability. The research and preparation as part of an extensive object-acquisition project is perceived as an unique task[37]. Both background information on Danish UN-forces in Bosnia and information on possibly related objects in the museum's collections was needed. The former is considered a topical or content related information need and the latter is a combination of a topical and muddled item information need. At the time of the interview the main part of the collecting-project had finished. The curator[38] explains how, despite detailed planning, additional information sources were consulted during the process and additional non-planned

[36] Curator 4: line 14

[37] Curator 9: line 53

[38] Curator 9: line 27

Table 6.3: Overview of relationships between types of work tasks, a priori determinability of work task, type of information needs, type of information needed in tasks, and information sources used.

Task type	A priori determinability	CI no.	Type of information need	Type of information needed	Main types of info. sources
Collection management	High degree of a priori determinability	1	Known item	FAC, VIS	Mainly internal sources: 'object documentation' and 'museum objects'
		2	Known item	FAC, VIS	
		3	Known or muddled item	FAC, VIS, PRO	
	Low degree of a priori determinability	4	Muddled item and known topic	VIS, PRO, ASS	See critical incident 8-15.
Inquiries	High degree of a priori determinability	5	Known item	FAC, VIS	Mainly internal sources: 'object documentation' and 'museum objects'
		6	Known item	FAC, VIS	
		7	Known data element	FAC, VIS	
Exhibition planning & design	Low to medium degree of a priori determinability	8	Known item and known topic	PRO, ASS	A wide variety of both internal and external sources are used. The most often used source is 'literature' followed by 'object documentation', 'experts' and 'museum objects'
		9	Known item	FAC, VIS, PRO	
		10	Known item and known topic	FAC, VIS, PRO, ASS	
		11	Known topic or content	FAC, VIS, ASS	
		12	Muddled item and topic	FAC, VIS, PRO	
		13	Known topic or content	FAC, VIS, PRO, ASS	
		14	Known item and known topic	FAC, VIS, PRO, ASS	
Research	Low degree of a priori determinability	15	Muddled item and exploratory topic	FAC, PRO, ASS	

Legend: Abbreviations applied to denote types of information needed: FAC: Factual, object related information, VIS: visual information, PRO: provenience information, ASS: associated historical context information objects were included in the collecting. This supports the low a priori determinability of this specific collection management task.

Answering of inquiries to the museum is the second object-related work tasks. It is characterised as highly repetitive and derived information needs extracted from the three critical incidents are either known item or known data element.

Almost half of the critical incidents relate to *exhibition planning and design*. The work tasks connected to exhibition planning and design are largely characterised as complex involving a variety of different sub-tasks, information sources (see section 6.3), and often covering a long time period. Especially the sub-tasks involving object-related searching, however, are described as more a priori determinable:

> *"We apply a new approach to the developing of the new permanent exhibition. We explore different ways of presentation, expressions, communication of stories, and how objects are used. We don't know yet where we are going. This said, the part about using the museum's object documentation [including the card catalogue, correspondence, accession protocols etc.] and locating objects is a well-known task. But then again it is different now because we emphasize the relation between 'a good story' and collections much stronger than earlier."* (Curator 2: line 16).

Likewise, curator 5 describes the planning and research of a special exhibition on the Danish military in the 1700 as an overall complex work task with many case based arbitrations. But like the above example, the curator characterises object-related search tasks as routine tasks:

> *"There is also a part of routine in the task, because I know our storages. I also know how to use and search the object catalogues".* (Curator 5: line 66).

The information needs derived from the work task of *exhibition planning and design* are a combination of primarily known item needs and topical or content needs. The known item needs relate to the verification and further study of object documentation (see examples in critical incidents 8, 9, 10, and 14 in Table 6.2) and reflect the curators' extensive knowledge of the collections. In most cases they know the museum objects very well together with the associated historic context information. Only critical incident 12 reflects a combined muddled or exploratory item and topical need, where the curator in question is faced with a topic and museum collection not familiar to her/him[39].

Only one single critical incident (number 15) relates to *research*. The research task reflects an exploratory topical information need related to purchase of weapons during the reign of the Danish King Christian the Fourth. The research task is similar to those of *exhibition planning and design*, but even less a priori determinable as the research project investigates an area where little research has been done and establishment of provenience information linking museum objects to the research topic is difficult[40].

6.1.3 Summary and discussion concerning museum curators' work tasks and derived information needs

To sum up, analysis of the interviews with ten museum curators from the Military Museum identified four main object-related work tasks: collection management, exhibition planning and design, research, and answering of inquiries to the museum from the public. The identified types of work tasks correspond largely to the main tasks of cultural heritage experts identified in a study by Amin et al. (2007).

Almost half of the critical incidents relate to exhibition planning and design, and in general the interviews reflected surprisingly few object-related information seeking needs related to collection management. Instead, curators mainly produce and add to existing information in the sub-tasks of collection management, e.g., when registering new objects or adding to existing descriptions.

Across the 15 critical incident descriptions, the above analysis of information needs identify two primary types of object-related information needs among curators:

1. *Object of prior familiarity:* a need to verify and pursue an all-ready known museum object (or elements of this object)
2. *Overview and exploration*: a need to explore and gain overview of objects related to a certain topic, collection, or time period.

[39] Curator 3: line 106

[40] Curator 2: line 16 and 38

The first information need type corresponds to known item or known data element in Ingwersen and Järvelin's (2005, pp. 292-293) typology of information needs. Information needs identified in critical incidents 1-3, and 5-7 are clear-cut examples of an *object of prior familiarity* information need.

In addition, critical incident 8-10 and 14 likewise represent an information need where an *object of prior familiarity* is the point of departure. Here, however, the information needs are combined known item and topical, where also a broader topical aspect of a museum object is pursued. For instance, information on Danish resistance groups and the late period of the Second World War provides a topical – non-object-related – context of the Danish resistance armbands and two military helmets (critical incident 8). Curators' information needs related to an *object of prior familiarity* is identical to how, according to Bates (1996a, p. 700), knowledgeable humanities scholars must have read closely and be intimately familiar with a large number of particular works and, for instance, a 200-item search is considered to be of great success if it produces one or two novel references. As an example, the following quote illustrates curator 5's prior familiarity with both museum objects and literature related to his/her topical area:

> "*I know our collections and storages very well. I know all the literature related to my topic and time period – off course. I have seen all the photographs in the relevant books and articles on the topic. […] I know our collection on uniforms forward and back. I have touched all the items. But in relation to the 4-5 other relevant collections, I had to go through all the catalogue cards just to be safe [that nothing important was missed]. And consequently, I found a few objects that I did not know we had.*" (Curator 5: line 82 and 84).

Whereas the first part of the quote reflects extensive *prior familiarity* of objects, the last part of the quote relates to the second primary type of object-related information needs: *overview and exploration*. This information need type corresponds to topical (whether known or exploratory) and muddled items in Ingwersen and Järvelin's typology of information needs. Critical incidents 4, 11-13, and 15 represent information needs related to *overview and exploration*. For example, as part of exhibition planning, curators 2[41] and 3[42] explain how they browse both the physical collections and catalogue cards in order to select objects matching the theme of an exhibition. An important element in their exploratory information needs is serendipitous discovery of unknown objects, new relationships between objects or inspiration. The curators currently need to make these connections manually when searching. Due to limited search entries and support for serendipitous discovery, curators rely on their cognitive and analytical skills in order to establish connections manually when searching. This is a finding also supported by Amin et al. (2007). Curators' exploratory object-related information needs likewise reflect a complexity in what constitutes 'a good museum object'. This aspect is further discussed in section 6.2.3.

Based on Byström and Järvelin's (1995) framework of task complexity, both *collection management* work tasks and *answering of enquiries* to the museum are characterised by high a priori determinability. Whereas work tasks of *exhibition planning and design* and *research* are characterised by low to medium a priori determinability. The combination of low to medium degree of a priori determinability in *exhibition planning and design tasks* and the high frequency of known item or topical information needs may seem contradictory. However, even though the item or topic is well-known the outcome and applicability of the information found is rarely easy predictable. This is due to the so-called *dual interaction* between museum objects (including their documentation) *and* the associated historic context (see also section 6.3).

The analysis shows how the four main object-related work tasks are highly interrelated. For example, research can be seen as a supportive task to both collection management and exhibition planning and design. Likewise, the quality and completeness of documentation is a crucial factor in relation to both exhibition planning and design and answering of inquiries. Despite the interrelatedness between work tasks, the following sections maintain a distinction between the different tasks which, together with the categorisation of work task complexity, help characterise curators' information seeking behaviour.

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[41] Curator 2: line 62 and 64

[42] Curator 3: line 89

6.2 The relationships between types of work tasks and types of information needed in those tasks

The second research question (1.b) concerns the relationship between types of work tasks and types of information needed in those tasks. Answering of the second research question is a direct continuation of the above section. That is, the type of information needed will be related to the four main object-related work tasks identified and the perceived work task complexity. First, however, section 6.2.1 suggests the importance of a historic context dimension.

6.2.1 Influence of historic context dimension

In the present thesis, a historic perspective on knowledge organisation and indexing of museum objects is valuable because it offers a broader perspective for understanding today's museums. This sub-section aims to illustrate how changes in the historic context dimension are reflected in the case museum. The section relates to section 3.1.1, primarily based on Hooper-Greenhill's (1992) analytical work, which describes how interpretation of museum objects is shaped by the historic and cultural context within which they are displayed.

As explained in the introduction to the case museum (section 5.2.1), The Military Museum can be described as a traditional museum of cultural history. However, during the last decade the museum has started a process of transformation. Earlier the museum had a narrower, typological focus on weapon history. Now the museum aims at becoming a museum of defence and weapon history with a broad cultural historic perspective (Christensen, 2006). To some extent, parallels can be drawn from the process of transformation taking place at the Military Museum to the shift of paradigmatic nature, outlined in section 3.1.1, from the traditional museum to the reinvented museum. An important evidence of this transformation taking place is the changing focus in the documentation and indexing of museum objects. Earlier focus was on the description of the visible features of the artefact and on placing the object within a typological classification. Now focus is on telling the story of the object:

> ”*The museum's profile has changed from being a technical, arts and crafts museum to a museum of cultural history. Earlier, interest was primarily in the technical aspects of the object. What calibre, the firing range, the objects place in the line of development etc. It was a question of presenting the long line of development from the earliest types to the most modern types. […] And it is*

> *obvious, that from that point of view 'the good story', which we emphasize today, is somewhat irrelevant.*" (Curator 1: line 50)

Curator 1 continues by explaining how the contextualisation of museum objects has become important:

> *"Our documentation [of museum objects] used to be very descriptive. That is, you wrote down what you could see […]. However, this objective information is maybe the least relevant, the least interesting. Instead it is all the other dimensions of the object that is relevant. Who was the user/owner, what is the story of this specific object, and what can we tell based on this specific object?"* (Curator 1: line 51)

The main parts of the Military Museum's collections have been collected, classified, and described predominantly from the perspective of the traditional museum. The following section address the relationship between types of work tasks and types of information needed. It shows how museum curators, as a consequence of the shift in curatorial perspective, are constantly challenged by what, from today's perspective, may be seen as incomplete object descriptions.

6.2.2 The relation between type of work task and types of information needed in those task

In this thesis, information is categorised from the perspective of the museum domain. In this view, information can be categorised into the following four types[43]:

1. *Factual, object related information*: physical description and measurements of the object, production year, type of object, country of production etc.
2. *Visual information or physical dimensions*: The museum object(s) or photograph of object(s)
3. *Provenience information*: who owned and/or used the object, when was the object used, in which countries was the object used etc.
4. *Associated historic context information*: Historic information on periods, persons, institutions, or events etc. associated to the museum object.

[43] The same categorisation of types of information is applied in chapter 7 on virtual museum visitors.

This section shows the relationship between the four types of information needed and work tasks. The results are summarised in Table 6.3 (column 5) in section 6.1.2.

The first two types of work tasks, *collection management* and *answering of inquiries*, both represent work tasks with a high degree of a priori determinability (see 6.1.2). In these two tasks mainly ‘factual, object related information’ and the ‘museum object’ (or perhaps a photograph of the object) are needed to cover the information need. Here it is important to notice that a combination of the two types of information, ‘factual, object related information’ and ‘museum object’ is necessary. This stresses the challenges in representing three-dimensional museum objects in textual representations as also pointed to by Chaudhry and Jiun (2005) and Orna and Pettitt (1998). For example, in critical incident 1 the typological classification of a large collection of edged weapons is based on both ‘factual, object related information’ (object type, physical description, and model year) from existing catalogue cards and handbooks *and* an examination of details on similar objects. Another example is critical incident 2, where the decision on which colours to send for conservation cannot be made solely based on the museum’s documentation but also relies on an examination of the objects in question.

In general, neither ‘provenience information’ nor ‘associated historic content information’ is needed in the work tasks of high a priori determinability. Critical incident 3 is a single exception. Here different internal sources of documentation are compared and related to discern provenience information more accurately on objects in a specific collection. Accordingly, provenience information is obviously central.

In contrast, the analysis of critical incidents in work tasks of low a priory determinability, *exhibition planning and design* and *research*, show that ‘provenience information’ and partly also ‘associated, historic context information’ is highly important and it is indicated in all critical incidents except critical incident number 11 (see Table 6.3 column 5). The curators repeatedly stressed the importance of ‘provenience information’ in relation to *exhibition planning and design*:

> *“Provenience information is crucial and just as important as the object itself. The provenience information of an object has a strong influence on how we can use the object in an exhibition and link an object to the historical context”.* (Curator 8: line 120).

Several curators[44] describe how strong provenience information can provide a link between the individual museum object and the historical context illustrating the theme of an exhibition. For instance, in connection with critical incident 8, curator 1 explains how two Danish resistance armbands and two military helmets can be used to illustrate a more overall theme of a beginning East-West conflict:

> *"The question is: how do we illustrate the main theme of the East-West conflict in an exhibition? We use an object. We have two Danish resistance armbands and two military helmets which belonged to members of a Danish resistance group […] and we have their personal accounts of what happened. We can use the 'little story' as a point of departure to tell the main story."* (Curator 1: line 16).

In this way the museum object itself is no longer the main interest. Instead the object has become a mean to an end illustrating and representing a context (Mordhorst, 2005, p. 11).

The interviews show how the museum curators take much effort in searching for and studying of provenience information. The reported difficulty of establishing precise provenience information and determining museum objects' links to historical, context information supports a low degree of a priori determinability of work tasks of *exhibition planning and design* and *research.* In critical incident 9[45], for example, further study of the armour from around 1500 proved earlier assumptions on a link to a specific historical person unlikely. Likewise, in critical incident 14[46], provenience information on the museum's Spitfire aircraft was also proven wrong and was later re-established. The two examples illustrate how difficulties in establishing provenience information result in low a priori knowledge of outcome of the work task processes.

This section has presented the results on the relationship between types of work tasks and four types of information needed in those tasks (see overview in Table 6.3 (column 5) in section 6.1.2). During analysis of the ten interviews it became evident; however, that curators' description of types of information needed often included a discussion of

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[44] Curator 1: line 16 and 30, curator 2: line 40 and 52, curator 5: line, and curator 8: line 20

[45] Curator 2: line 38

[46] Curator 8: line 112

what constitutes 'a good museum object'. Accordingly, the second coding of the interview transcripts included coding of 'what constitutes a good museum object' and 'attributes of a good museum object' in order to further explore this highly subjective notion. The results are presented in the following section.

6.2.3 What constitutes 'a good museum object'?

Primarily in connection with research as part of object acquisition and in connection with exhibition planning and design, the museum curators often discussed the notion of what constitutes 'a good museum object'. Two different types of 'good museum objects' were identified:

1. *A representative object,* or
2. *An object of narrative or visual power*

A representative object is used to, e.g., illustrate a certain type of object, a technical development, or a time period[47]. In critical incident 11, for example, the curator searched for objects illustrating the exhibition theme of technical development of means of military communication[48]. When selecting a *representative object,* provenience information is secondary and therefore not indicated as type of information needed in critical incident 11 (see Table 6.3). The curators' main challenge in relation to finding and selecting 'a good' representative museum object is to get an overview of the collection.

The second notion of what constitutes 'a good museum object' has lately become very important given the Military Museum's aim at developing exhibitions focused on telling stories based on authentic museum objects (see section 6.2.1). An often mentioned attribute in relation to an object's narrative power was 'authenticity'[49]. The authenticity relates to the unique story of a given museum object and again the importance of capturing provenience information is stressed:

[47] Curator 2: line 62, 20; curator 3: line 93.

[48] Curator 3: line 93.

[49] Curator 1: line 38; curator 8: line 20; curator 9: line 75; curator 10: line 6

> *"It is crucial to capture and explain the authenticity of an object. That is, to document the provenience of the individual object. We spend so much time struggling to verify anonymous objects in our storages."* (Curator 9: line 75).

Likewise, the *visual power* of a museum object is important. In critical incident 9, for instance, the curator explains how the specific armour has a strong dramatic and visual effect because of three stab holes in the back of the armour[50].

The critical incidents illustrate that, what constitutes a 'good museum object' of narrative or visual power is highly situational and subjective and thus difficult to systematically represent in the indexing process. Further, attributes of 'a good museum object' relates to all four main types of information ('factual, object related information', 'object or photograph of object', 'provenience information', and 'associated, historical context information').

6.2.4 Summary of results and discussion of findings concerning work tasks and types of information needed

Introductory, section 6.2.1 describes the importance of adding a historic dimension on knowledge organisation and indexing of museum objects and how the historic dimension influence the type of information needed in curatorial work tasks. Building on Hooper-Greenhill's (1992) analytical work, the section suggests a change in focus from *factual and object related information* to a focus on *provenience information* and *associated, historical context information* as the contextualisation of museum objects has become important. The influence of a historic context dimension is not often discussed in IS&R literature. An exception is Ingwersen and Järvelin (2005, pp. 281-282) who mention the historic context dimension as a temporal form of context forming all participating actors' experiences. The present analysis shows the importance of acknowledging the influence of a historic context dimension, especially when the collections in question cover information objects produced through a long time period.

Section 6.2.2 analyses the relation between type of work task and type of information needed in those tasks. The results show how a combination of 'factual, object related information' and the 'museum object' is needed in the two work tasks representing a

[50] Curator 2: line 56

high degree of a priori determinability: *collection management* and *answering of inquiries.* In contrast, analysis of the work tasks of medium/low a priori determinability, *exhibition planning and design* and *research*, shows that variety of types of information are needed including ‘provenience information’ and also ‘associated, historical context information’. Table 6.3 show an overview of the relationship between types of work tasks and types of information needed. The findings support Byström and Järvelin’s conclusion, that as task complexity increases, the information need also become more complicated and the variety of information needed increases (1995, p. 208).

The curators’ object-related search tasks regarding, e.g., research on provenience and exploring associated historic information, result in a need for contextual information. The results presented in the following section illustrate how these more complex information needs cannot be met by internal sources alone.

6.3 Museum curators’ use of information sources

In order to further characterise the information seeking behaviour of museum curators, the third research question (1.c) explores the relationship between work tasks and types of information sources used. Section 6.3.1 describes findings related to curators’ use of information sources based on their descriptions of critical incidents and section 6.3.2 summarises and discusses the results.

6.3.1 Museum curators’ use of information sources based on critical incidents

The present section explores the variety and internality of information sources used by museum curators related to both work task complexity *and* type of work tasks. Curators’ use of electronic versus non-electronic channels was not considered explicitly as the pre-study of informal knowledge gathering had shown a general low use of technology and electronic channels. This observation is supported by findings of humanist scholars’ low use of technology (Bates, 1996b; Watson-Boone, 1994; Wiberley & Jones, 2000).

The internality/externality of sources was judged on the basis of where the source was available, not where it was produced. Further, the types of information sources were classified as:

1. *Museum objects or collections*
2. *Other primary sources* than museum objects, e.g., archival material
3. *Object documentation* including manual and computerized catalogue cards, accession protocols, correspondence related to objects etc.
4. *Personal collections* including curators' personal notes, correspondence etc.
5. *Literature* both research literature and non-research literature such as books, handbooks, articles, newspapers, newsletters etc.
6. *Experts* including knowledgeable colleagues

Table 6.4 presents the information sources used for each of the 15 critical incidents. In work tasks of *collection management* and *answering of inquiries*, the two most often occurring information sources are 'museum objects' and 'object documentation'. This is not surprising since the results from section 6.2 illustrate how mainly a combination of 'factual, object related information' and the 'museum object' as a type of information is needed in these two types of work tasks. In addition, 'literature' was mentioned as a consulted information source in critical incident 1, 4, and 7.

The interviews also reflect how curators' choice of information sources is at least partly influenced by ease of source accessibility. In critical incident 7, for example, the curator is looking for physical measurements of two-handed swords. First, the curator consulted internal object documentation in the form of catalogue cards which were easy accessible on his/her computer. The catalogue cards only provide an answer for some of the swords, and therefore he/she consulted a handbook from the museum's own library (next door to the curators' office). This source likewise only provided a partial answer. Accordingly, the curator went to the exhibition building and manually made the remaining measurements using the museum objects as information sources. In critical incident 1, ease of source accessibility was also decisive. Catalogue cards were first consulted but did not give a complete answer. Therefore the curator turned to a colleague and next to literature from the museum's library. The colleague was consulted prior to the handbook due to easy accessibility and known reliability.

Table 6.4 Information sources and channels used in work tasks of professional museum curators

Type of task and sub-task (critical incident number)	**Information sources used**
Collection management:	
1 Object acquisition	Museum objects (obj-int); Catalogue cards (doc-int); Handbook on military weapons from the museum's library (lit-int); Colleagues (exp-int).
2 Select objects for restoration	Museum objects in colour collection (obj-int); Catalogue cards (doc-int).
3 Prepare object acquisition	Museum objects (obj-int); Catalogue cards, correspondence related to objects (doc-int)
4 Prepare object acquisition	Catalogue cards (doc-int); Field-trip (pri-ext); Literature from the Museum's library, news media (lit-int); Newsletter from the Danish Defence (lit-ext); Colleagues (exp-int); Contact person in the Danish Defence (exp-ext).
Answering of inquiries:	
5 Find object information and specific objects	Objects in storage (obj-int); Catalogue cards (doc-int).
6 Find information and photo	Register of military vessels, photograph of object (doc-int).
7 Verify physical measurements	Objects in exhibition (obj-int); Catalogue cards (doc-int); Handbook from the museums library (lit-int).
Exhibition planning & design:	
8 Object selection and documentation of objects	Catalogue cards, accession protocols, correspondence (doc-int); Research literature (lit-int) and (lit-ext).
9 Object selection and documentation of object	Catalogue cards (doc-int); Personal notes (per-int); Research literature (lit-int)
10 Object selection and presentation of information on a special collection	Colours related to the specific battle (obj-int); Catalogue cards, registers, correspondence (doc-int); Resume of internal documentation (per-int); Archival material (pri-ext); Swedish research literature on the topic (lit-ext).
11 Object selection and	Objects in collection on communication (obj-int);

presentation of information	Catalogue cards (doc-int); Literature on the topic (lit-int) and (lit-ext).
12 Object selection	Special collection on Russian uniforms (obj-int); Catalogue cards (doc-int); Literature on military uniforms (lit-int) and (lit-ext); Expert knowledgeable on this specific collection (exp-ext).
13 Object selection	Collection on uniforms (obj-int); Archival material from the Danish National Archives (pri-ext); Catalogue cards (doc-int); Own research notes on topic (per-int); Research literature (lit-int) and (lit-ext); Informal network group of historians working with different aspects of the 1700 period, and museum curator from other museum (exp-ext).
14 Object selection	The specific spitfire aircraft (obj-int); Catalogue cards and correspondence (doc-int); Curator's correspondence (per-int), Literature (lit-ext); Museum curator from the Danish Technical Museum (exp-ext).
Research:	
15 Research on purchase of weapons during the reign of King Christian IV	Catalogue cards (doc-int); Archival sources (pri-ext); Personal research notes on sub-set of museum objects (per-int); Research literature (lit-int).

Legend: The following abbreviations are used in table 6.4:

obj = museum objects or collections, pri = other primary sources, doc = object documentation

per = personal collections, lit = literature, exp = experts, int = internal sources, ext = external sources

With a single exception, only internal sources were consulted in the critical incidents related to *collection management* and *answering of inquiries*. In relation to source internality, curator 5's explains how he/she answers 70-80% of all inquires related to his/her time period and topics based on written sources he holds within his office[51]. This supports a high source internality in less complex work tasks. The single exception, mentioned before, is critical incident 4 which in contrast to the other *collection management* tasks is categorised as having a low degree of a priori determinability. In critical incident 4 (see Table 6.4), more information sources, both internal and external,

[51] Curator 5: line 163

were consulted than in the other critical incidents related to *collection management* and critical incidents related to *answering of inquiries*.

The findings from critical incident 4 are in line with findings from the other critical incidents related to work tasks of either low or medium a priori determinability. That is, a wider range of both internal and external sources are applied in work tasks related to *exhibition planning and design* and *research* than in work tasks of low complexity. This is also evident from Table 6.5 below which illustrate the relation between types of sources used and work task complexity. Due to the relatively low number of critical incidents, a distinction is only made between tasks of high versus low/medium complexity in Table 6.5. The table confirms, that in work tasks of high a priori determinability, ‘object documentation’ followed by ‘museum objects’ are the most highly used sources. Whereas in more complex work tasks of low/medium a priori determinability, it is ‘literature’ which is the most frequent used type of source followed by ‘object documentation’. These findings correspond with the results related to research question 1.b (see 6.2.4) showing that complex work tasks are characterised by the need for provenience and/or associated, historical context information. These two types of information are often only partially found in the museums documentation, and hence use of external sources is necessary. The following two quotes reflect how curators turn to external sources in work tasks of low/medium a priory determinability. First, in relation to critical incident 14, curator 8 explains how the museum’s documentation of objects related to aviation and the air force is insufficient:

> “*In general the catalogue cards can only be used to identify the object and point to the type of object. But if you need further information, you have to look elsewhere. […] Accordingly, we rely heavily on external sources.*” (Curator 8: line 112)

Likewise, in relation to critical incident 10, curator 2 explains which sources are used in connection with establishing provenience information on military colours potentially related to the ‘Battle of Lund’ in 1676:

> ”*To a large extent our catalogue cards only state a conclusion and we have to re-construct all the elements the conclusion is based on. […] We have used literature by some Swedish researchers and related it to original sources describing the battle. We compare different sources to see what information can be confirmed and what is just confirmed guessing. In addition, we also have some internal*

> *registers and correspondence which include some relevant parts.*" (Curator 2: line 52 and 54)

The two quotes illustrate the *dual interaction* between museum objects (including their documentation) and the associated historic context.

Finally, inspired by Byström and Järvelin (1995), the *source internality index* and the *type of source count per task*[52] were measured. The *source internality index* reports the percentage of internal sources among the sources used. It shows that work tasks of high a priori determinability rely on internal sources (index 100), whereas a lower *source internality index* (index 61) is measured in work tasks of low a priori determinability (see Table 6.5). The *type of source count per task* shows that twice as many types of sources are used in work tasks of medium/high complexity than in work tasks of low complexity.

[52] In Byström and Järvelin's (1995) study the *source count per task* was based on the number of individual used sources. As explained in section 5.5, the interviews in the present study did not provide detailed enough information of all critical incidents to count all individual sources used. For instance, information on whether two or three research articles were used in relation to a work task. Instead, the number of *types of sources* used per task was counted.

Table 6.5 Information sources and channels used in work tasks of professional museum curators

Task property	**Type of work task according to task complexity**					
	Work tasks of *high* a priori determinability (critical incidents 1- 3 and 5-7)			Work tasks of *low* a priori determinability (critical incidents 4, 8-15)		
	Number of internal sources	Number of external sources	%	Number of internal sources	Number of external sources	%
Types of sources used						
- museum objects (obj)	5	0	36	6	0	14
- other primary sources (pri)	0	0	0	0	4	9
- object documentation (doc)	6	0	43	8	0	19
- personal collections (per)	0	0	0	5	0	12
- literature (lit)	2	0	14	6	7	32
- experts (exp)	1	0	7	1	5	14
Total	14	0	100	26	16	100
Source internality index	100			61		
Type of source count per task	2.3			4.8		

6.3.2 Summary of results and discussion of findings concerning information sources

Curators' use of information sources were analysed from a work task perspective. Based on the 15 critical incidents, the results show two distinct patterns of use of information sources when comparing work tasks of low complexity (*collection management* and *answering of inquiries*) with work tasks of medium/high complexity (mainly *exhibition planning and design* and *research*). Work tasks of low complexity have very high source internality and the most often used sources were a combination of 'museum object' and 'object documentation'. In contrast, work tasks of medium/high complexity have considerably lower source internality and a wider variety of sources were needed. The results support earlier findings of work task complexity (Byström & Järvelin, 1995; Byström, 2002) in relation to how increase in work task complexity result in an increase of number of source applied and an decrease in source internality.

The analysis further stresses the importance of original sources. Across types of tasks, curators' dependence on original sources is predominant. This correlates with studies of academic historians (Case, 1991; Tibbo, 2002). E.g., Case describes use of primary sources as the heart of what academic historians do (Case, 1991, p. 74). The results from the present study suggest extending this notion in regard to historians as museum curators. That is, the *dual interaction* between museum objects (including their documentation) and the associated historic context is central to museum curators.

Finally, a preference to written information sources over personal sources like colleagues and other experts was identified.

A main challenge experienced by curators, especially in relation with complex work task, was research on and establishment of provenience information relating the individual object to a broader historical context. This is a challenge not automatically solved by digitization projects. Instead, from an information system point of view it is essential to support the diversity of sources used and also support capturing of essential contextual data and get them documented during the work process. The latter aspect is also pointed to by Vatanen, Lehtonen and Uotila (2006) in relation to archeological information systems.

7 Results regarding virtual museum visitors

This chapter reports on the results regarding virtual museum visitors' information seeking behaviour in a virtual museum context. The following research questions are answered and discussed with the objective to explore and gain insight into how resource descriptions of museum artefacts is searched for and used in the information seeking process of virtual museum visitors:

2 What characterises information seeking behaviour of *virtual museum visitors*? As to:

- 2.a Their information related leisure tasks and derived information needs?;
- 2.b Which data elements are preferred in a searchable record of museum artefacts and why?;
- 2.c What information channels and sources are used in what kinds of leisure tasks?; and
- 2.d What characterises searching behaviour of virtual museum visitors, with focus on how different task types affect search attributes and search strategies?

The following four sections (section 7.1 to 7.4) each cover a research question. In order to provide a rich characteristic, results and analysis regarding each research question draw on data across the different data collection methods described in section 5.2. Each of the four sub-sections concludes with a discussion and summarisation of the results regarding virtual museum visitors.

7.1 Virtual museum visitors' leisure tasks or interests and derived information needs

As a first step to characterise information seeking behaviour of virtual museum visitors, this section answers research question 2.a as to their information related leisure tasks and derived information needs. Before the leisure tasks are described, section 7.1.1 starts by providing an understanding of the *leisure context* in the present case study. Stebbins's (1982; 1994; 2003; 2007) theoretical work on the serious leisure perspective, discussed in section 4.2.2, is applied to characterise the leisure context of the specific group of virtual museum visitors to the Military Museum's online catalogue. Next, section 7.1.2 describes findings on information needs identified in both written enquiries to the museum as well as in data from the web questionnaire. Finally, results from the qualitative interviews with user study participants, the main empirical data source on virtual museum visitors' leisure tasks and derived information needs, are presented in section 7.1.3. They provide detailed knowledge on real-life information needs in a leisure task context.

7.1.1 Characteristics of the participating hobbyists and their leisure tasks or interests

Data from the web survey provides a first hand impression of the leisure context as to visitors' interest areas. Table 7.1 shows that the two most often indicated interest areas are 'a specific object type' (indicated by 61.4% of respondents) and 'defence and military history in general' (indicated by 57.6% of respondents). This and the following sections show how these two answer categories, although overlapping, often cover two rather different approaches to defence and military history as a leisure interest. Results from the web survey further show that respondents are interested in different historic aspects, like specific defence and military history events (31.8%), specific defence and military history era (15.9%) or history in general within a time period (12.1%). Finally, small groups of respondents are interested in *activities* of historical re-enactment, genealogy, or making of military miniatures. Table 7.1 also shows that the recruited participants in the user study cover all interest areas identified among web survey respondents except one (local history).

Table 7.1: Characteristics of hobby or interest areas based on data from web questionnaire (survey question 4, see appendix 4). Respondents were allowed to indicate more than one interest area.

Description of hobby or interest area	All hobbyists respondents, n=132		Respondents participating in user study: All, n=24		Collectors, n=16		Liberal arts enthusiasts, n=8	
	#	%	#	%	#	%	#	%
1. Defence and military history in general	76	57.6	16	53.3	9	56.3	7	87.5
2. Specific period of defence and military history	21	15.9	4	13.3	4	25.0	0	0
3. Specific defence and military history event	42	31.8	6	20.0	4	25.0	2	25.0
4. A specific object type	81	61.4	19	63.3	15	93.8	4	50.0
5. History in general within a time period	16	12.1	6	20.0	5	31.3	1	12.5
6. Genealogy	5	3.8	1	3.3	1	6.3	0	0
7. Local history	6	4.5	0	0	0	0	0	0
8. Re-enactment	10	7.6	2	6.7	1	6.3	1	12.5
9. Military miniaturism	9	6.8	1	3.3	0	0	1	12.5
10. Other	18	13.6	0	0	0	0	0	0

Legend: The table shows both data related to hobbyists respondents from the web questionnaire (n = 132), data related to participants in the user study (n = 24), and data related to each of the two sub-groups of user study participants: collectors and liberal arts enthusiasts.

Comparison between the two independent variables, age and knowledge level, and respondents' description of hobby/interest area, showed only few differences. Chi-square tests (see appendix 8) showed that significantly more young respondents (age 16 to 45) than older respondents (age 46 to 83)[53] engage in re-enactment, whereas the opposite holds for genealogy. No differences were identified between age and the remaining interest areas (see appendix 8). With regard to knowledge level, significantly more highly experienced respondents than novices pursue an interest in either a specific defence or military history period or event (see appendix 9). This may reflect how more

[53] Respondents' median age was 45 years. The median divided the respondents into two groups of equal size. A group of respondents age 16-45 and a group of respondents age 46-83.

specific interest areas are developed during the hobbyist's career. No differences were identified between knowledge level and the other interest areas (see appendix 9).

We now move empirically from the web questionnaire data to the user study's interview data to gain a more in-depth understanding of participants' hobbies. Table 7.2 shows an overview and a short description of the 24 user study participants' hobbies categorised according to Stebbins's five hobby types. When participants' hobbies were categorised, a clear distinction between two main groups of hobbyists emerged. *Collectors* form the largest group and *liberal arts enthusiasts* of defence and military history the other main group. In general the interviews show how *collectors* are focused on building, developing and maintaining their private collections. Objects are collectors' primary interest, while the historical context is secondary. This is reflected in the following quotes of how collectors define their interest area:

> *"[I'm interested in] Danish military weapons. The technical line of development. Not specifically the Battle of Isted [a specific battle in 1850] and what decisions were made and why they lost. That is interesting entertainment in connection with pleasure reading. But it is the weapons that are interesting."* (Participant F: line 21).

> *"The historical eras [in the online catalogue] suggest that you are interested in a historical period. That you interested in the political situation and from there you orient yourself towards the detail level of objects. My interest goes the other way around. I become fascinated by an object and start by examining the object and then I look into how it has been used and its historical relations."* (Participant Q: line 96).

> *Interviewee R: "I'm primarily interested in the First and Second War of Schleswig, but in recent years my interest has develop to include earlier periods as well because of a specific information source […]. It is both firearms and edged weapons but preferably no later than the Second War of Schleswig - and only Danish and military weapons.*
> *Interviewer: Are you also interested in the history of this time period?*
> *Interviewee R: No. Of course, I know some of the history outline and I know a little of what went on. But it is primarily the objects that interest me and then a little history related to them."* (Participant R: line 21).

Liberal arts enthusiasts, on the other hand, define their hobby as a broader historical interest, while the objects are secondary:

> *"The objects as such are less important to me because I'm interested in the objects in a historical context. How the objects have been used in a human context. How have they been used, where have they been used, by whom, and what have they caused. The colonial history: "We have the Maxim gun and they have not."* (Participant X: line 91).

> *"I'm interested in military history from a general historic point of view. That is, how the military history development affected the general history development. Besides that, I'm interested in German military history from 1700 and forward. I would say… social and structural war history and its influence. […] Objects become interesting because they help explain how some weapons, that apparently were judged decisive, were used."* (Participant Y: line 20).

The boundaries between hobby types observed in the case study are overlapping. This is evident from Table 7.2 where, e.g., six of the eight liberal art enthusiasts are also categorised as collectors. However, the interviews, exemplified by the two quotes of liberal arts enthusiasts above, show how liberal arts enthusiasts emphasise the historical perspective and accordingly the collection of objects is secondary. This can explain why only 50% of liberal arts enthusiasts indicate that they are interested in a specific type of object; whereas 93.8% of collectors pursue this interest (see Table 7.1). Like liberal arts enthusiasts, also collectors pursue historical information but with a more narrow and object centred focus. Accordingly, more liberal art enthusiasts than collectors indicate an interest in 'defence and military history in general'[54] (see Table 7.1). This characteristic applies well to Stebbins' proposal that the difference between the two classes of hobbies is partly the nature of knowledge acquisition. According to Stebbins (1982, p. 261), *collectors* pursue technical knowledge of the commercial, social, and

[54] Following this line of thought it is, however, difficult to explain why more collectors than liberal arts enthusiast indicate an interest in 'history in general within a time period' (see Table 7.1).

Table 7.2: Description and categorisation of the 24 user study participants' hobbies or interest areas.

Parti-cip.	Type of hobby					Short description of each user study participant's hobby
	C	M	A	P	L	
A	X					Collector of edged weapons, powder horns etc. and markings on weapons - both regimental and proof markings.
B	(X)				X	Collector of edged weapons. Broad interest in military history, chemistry and meteorology especially in the 1900 century.
C	X					Collector of historical weapons. Interest in 1800-1900 weapon history.
D	(X)				X	Collector of original unpublished photographs from the Second World War. Interested in defence and military history in general and from an economic and political perspective.
E	X		X	X		Collector, hunter, and participates in sport shooting.
F	X					Collector of Danish military weapons.
G	(X)				X	Collector of Danish edged weapons 1600-1810. Broad defence and military interest in the same time period. Especially the Napoleon wars.
H	X		X			Collector and hunter. Special interest in the Danish military 1850-1925.
I	X					Collector of hand weapons from 1848 and forward as well as accessories like bayonets, bags, helmets, etc.
J	X			X		Collector of bayonets. Sport shooting with historical weapons.
K			X	X	X	Activity participant in historical role-playing. Sport shooting. Broad historical interest.
L	X		X			Collector of Danish hand weapons from 1800 and forward together with accessories. Hunter.
M	X					Collector of primarily naval (marine) edged weapon.
N	X					Collector of regimental label badges
O	(X)				X	Collector of primarily uniforms from 1900 century. Broad historical interest.
P	X					Collector of photographs of military uniforms about 1864-1914.
Q	X			X		Collector of hand weapons. Sport shooting (both historical black powder shooting and shooting with modern pistols)
R	X					Collector of Danish military hand weapons and edged weapons. Primarily interested in the period of the First and Second War of Schleswig (1848-1851 and 1864). Also collector of model trains, pocket watches, old cars etc.
S	X			X		Collector of hand weapons. Participates in historical black powder shooting. Interest in specific aspects of the Second World War and in historical re-enactment (is not a re-enactment activity participant).
T	X					Collector of Danish military hand weapons from 1860 to 1945.
U	X	X				Collector of ammunition. Interested in the period from 1864 to 1945 – especially the Second World War. Repairs historical weapons belonging to museums, private collectors etc.
V				X	X	Sport shooting. Broad interest in the Second World War.
X	(X)				X	Collector of Danish weapons. Broad interest in the historic context of the artefacts, e.g., Danish colonial history.
Y	(X)				X	Collector of military artefacts related to the Second World War. Interested in military history from a general historic perspective. Specific interest in German military history from 1700 forward.
Total	23	1	4	6	8	

Legend: C = collectors, M = Makers & tinkers, A = activity participants, P = players of sports & games, L= liberal arts enthusiasts (marked with grey shading).

physical circumstances in which items are acquired along with knowledge providing a broad understanding of items' historical and contemporary production and use. *Liberal arts enthusiasts*, on the other hand, seek broad and humanising knowledge (Stebbins, 1994, p. 175). This difference in regard to knowledge acquisition is further discussed in the following as it is reflected in both military history hobbyists' leisure tasks and derived information needs. Based on cluster analysis (see section 5.4.2.3), the distinction between the two hobby types is also applied to the web questionnaire data.

The present study focuses on the two main hobby types identified (collectors and liberal arts enthusiasts). This said, Table 7.2 shows that also the three remaining hobby types were identified among the user study participants. The three remaining hobby types are makers and tinkers (one participant repairs historical weapons), activity participants (four hunters) and players of sports and games (six participants are sport shooters with modern and/or historical weapons). They are all either collectors or liberal arts enthusiasts as well, and their information related tasks and derived information needs are mainly concerned with these hobbies. Consequently, this study views the activities of the *maker and tinker*, the *activity participants* and the *players of sports and games* as related to either collecting or the hobby of liberal arts enthusiasts.

Common for the respondents is that they pursue knowledge on defence and military history and in their search for information they use the Military Museum's online catalogue as one of several information resources. The majority of respondents in the web survey have either 'some experience' or are 'highly experienced' (see Table 7.3). This also holds for participants in the user study, where no novices are recruited. All participants in the user study (except one, participant V) have had this hobby for more than ten years, and at least the ten highly experienced participants can be categorised as lay-experts within their sub-fields. Not surprisingly, a chi-square test shows a strong correlation between age and knowledge level, as significantly more respondents aged 46 to 84 classify themselves as "highly experienced" compared to the group of younger respondents aged 16 to 45 (see appendix 10).

Table 7.3: Description of respondents' knowledge level in relation to their hobby or interest area. The table is based on data from the web survey (question 7, see appendix 4). The table shows both data related to hobbyists respondents' from the web survey (n = 132) and data related to participants in the user study (n = 24). The latter forms a sub-group of the former.

Knowledge level in relation to hobby or interest area	All hobbyists respondents, n = 132		Respondents participating in user study: n = 24	
	#	%	#	%
I'm a novice with little knowledge within this area	14	10.6	0	0
I have some experience and background knowledge	76	57.6	13	54.2
I'm highly experienced and have extensive background knowledge	40	30.3	10	41.7
I don't know	2	1.5	1	4.2
Total	132	100	24	100

7.1.2 Information needs expressed in the written enquiries and web questionnaire

The first step taken to explore information needs was to analyse a total of 179 object- and collection-related written enquiries to the museum (containing 226 requests). Even though the written enquiries do not necessarily reflect information needs of *virtual* museum visitors, they do partially reflect the group of none in-person visitors (see also section 5.4.1). Table 7.4 shows a categorization of the 226 requests according to Ingwersen and Järvelin's (2005, p. 291) eight intrinsic information need types. Information needs reflecting *data element searching* is the most frequent occurring information need type followed by information needs reflecting *item searching*. Data element related information needs are defined by searching for *a priori structured* information entities (Ingwersen & Järvelin, 2005, pp. 291-292), exemplified by written enquiries for particulars on specific museum objects or types of objects, e.g., production year, physical measurements (weight, height and length), country of production, and name of manufacturer. These are all structured data. Item related information needs, on the other hand, are defined by searching for *unstructured* information objects or passages of contents, e.g., like enquiries for descriptions or photographs of objects. In the written enquiries both item and data element related information needs are mostly focused on objects. Information needs reflecting *topical* searching takes a broader view and seek to clarify, review or pursue unstructured information, for instance, 'how did the first hunter corps' [in Danish: jærgerkorps] uniforms from 1787 look like' or ‘something about the Danish military during the Northern wars 1657-1660, such as weapons, equipment, and rights and obligations of a soldier”. Only 3% of the enquiries reflect *factual* information needs.

Table 7.4: Categorization of written enquiries according to Ingwersen and Järvelin’s (2005, p. 291) eight intrinsic information need types.

Types of information needs identified in enquiries	Well-defined #	Ill-defined #	Total #	Total %
Item search	26	40	66	29.2
Data element search	48	43	91	40.3
Topical search	18	44	62	27.4
Factual search	7	0	7	3.1
Total	99 (43.8%)	127 (56.2%)	226	100,0

Surprisingly, only about half of the written enquiries (56%) can be characterized as exploratory. Based on our hypothesis about (virtual) museum visitors’ exploratory information seeking behaviour, a higher percentage of ill-defined or muddled information needs reflecting exploratory and semantically open search tasks was expected. However, the written enquiries do not reflect virtual museum visitors’ information needs, which might explain the lower share of exploratory needs than expected. The distinction between ill-defined and well-defined information needs relates to the quality of current knowledge of the information seeker, which can take a continuous range of levels (Ingwersen & Järvelin, 2005, p. 291). Information needs were categorized as ill-defined when they contained insufficient or wrong data or when the task / topic / object was only vaguely described. As an example, the first topical information need above illustrate a well-defined need whereas the second illustrates a more ill-defined or muddled need. More examples of well and ill-defined information needs are given in Table 7.8.

In order to investigate *virtual* museum visitors’ information needs, we turn to data from the web questionnaire. The question on purpose of visit to the museum’s web site shows that the two most frequent purposes were to find: 1) information on a generic item type, and 2) a photograph or illustration (see Table 7.5). Less common were broader, topical related purposes like ‘general knowledge on defence history’ and ‘knowledge on the museums collections’. When questionnaire respondents were classified according to the two main hobby types, based on cluster analysis as explained above, chi-square tests supported the different focus of collectors and liberal arts enthusiasts. Chi-square tests showed (see appendix 11) that significantly more collectors than liberal arts enthusiast indicate an object-related primary purpose of visit (information on a specific object, information on a specific type of object or finding a photo). On the other hand, significantly more liberal arts enthusiasts indicate a more broad purpose of visit (pursue knowledge on defence and military history in general) (see appendix 11).

The same pattern is partially found when comparing responses from user study participants divided into collectors and liberal arts enthusiasts (based on the qualitative interviews). Again, a notably difference between the two hobby types is that 'finding a specific type of museum object' is indicated as purpose of visit by 93.8% of collectors, whereas it is only indicated by 50% of the liberal arts enthusiast (see Table 7.5). This supports collectors' object centred focus.

Table 7.5: Purpose of visit to the Military Museum's online catalogue. Data from the web questionnaire (question 8, see appendix 4). Respondents were allowed to indicate more than one purpose of visit. In average each respondent indicated 2.7 purposes of virtual visits.

Purpose of visit to the Military Museum's online catalogue	**Data from web survey:** All hobbyists respondents, n=132		Respondents participating in user study: All, n=24		Collectors, n=16		Liberal arts entusiasts, n=8	
	#	%	#	%	#	%	#	%
1. To gain knowledge of the museum's collections	59	45.4	8	33.3	7	43.8	1	12.5
2. To gain knowledge of defence and military history in general	54	41.5	9	37.5	6	37.5	3	37.5
3. Find a photograph or illustration	66	50.8	9	37.5	7	43.8	2	25.0
4. Find information on a specific museum object	47	36.2	14	58.3	10	62.5	4	50.0
5. Find information on a specific type of museum object	80	61.5	19	79.2	15	93.8	4	50.0
6. Plan a visit to the museum	28	21.5	3	12.5	1	6.3	2	25.0
7. Find links and references to literature	18	13.8	3	12.5	3	18.8	0	0
8. Other – please specify	7	5.4	1	4.2	0	0	1	12.5
9. I don't know	2	1.5	1	4.2	0	0	1	12.5

Finally, in continuation of the question on purpose of visit, respondents in the web survey were asked whether they found what they were looking for on the Military Museum's web site. Table 7.6 shows that 30% of the respondents were *not* looking for anything specific. This is an interesting finding supporting an exploratory seeking behaviour. It supports that leisure tasks and derived information needs of virtual museum visitors are not necessarily initiated by a problem, but rather driven by interest. An issue further explored in the following section 7.1.3.

Table 7.6: Data from web questionnaire on expectation of virtual visit (question 9, see appendix 4). Respondents were only allowed to indicate one answer.

Did you find what you were looking for on the Military Museum's web site?	Web survey			
	All hobbyist respondents		Respondents participating in user study	
	#	%	#	%
1. I found what I was looking for	52	39.4	7	29.2
2. I found some of what I was looking for	34	25.8	10	41.7
3. I didn't find what I was looking for	5	3.8	2	8.3
4. I was not looking for anything specific	39	29.5	5	20.8
5. I don't know	2	1.5	0	0
6. Total	132	100.0	24	100.0

Together, the analysis of written enquiries and the virtual museum visitors' indication of purpose of visit show the spread of enquiries (see Table 7.4 and Table 7.6). It reveals that the majority of information needs relate to specific objects or types of objects, whereas topical information needs and visits related to broader level knowledge on defence and military history in general are less frequent.

7.1.3 Leisure tasks and derived information needs expressed in the interviews

The user study provides additional, explanatory information on leisure tasks and derived information of the virtual museum visitors. As pointed to by Vakkari (2003, p. 417), work tasks can be analysed at different levels of granularity and defining a task and its subtasks should be dictated by the research questions of the study. In the present study, the main leisure tasks of hobbyists are defined according to their hobby type.

Table 7.7: Information related leisure tasks and derived information needs identified in interviews with hobbyists, n = 24.

Hob-by	Information related leisure tasks or interest	#	General description of derived information needs	Types of info. needs identified based on critical incident method
C	Build and maintain 'archives' related to private collection	22/23	Collect object related information and/or historical context information	Known item (18) Exploratory item (3) Known topic (1)
C	Information sharing: Build and maintain 'archives' for a wider audience	5/5	Collect object related information	Known item (3) Known data element (2)
C	Information sharing: write books, articles, posting in news groups, discussion with peers, etc.	1/23	Collect object related information	Known item (1)
M	None identified	-	-	-
A	None identified	-	-	-
P	Extend knowledge on historical firearms used for sport shooting	1/6	Collect object related information on historical firearms used for sport shooting	Known item (1)
L	Pursue general interest	3/8	Collect historical information on a time period, historic event, etc. Object related information is not in focus	Exploratory topic (3)
L	Information sharing: write books, articles, posting in news groups, discussion with peers, etc.	0/8	Collect historical information on a time period, historic event, etc. Object related information is not in focus	None identified
C/M/A/P/L	Exploration of hobby or interest	7/>7	Explore information related to hobby	Exploratory item / element / topical / factual

Legend: C = collectors, M = makers & tinkers, A = activity participants, P = players of sports & games, L = liberal arts enthusiasts. In column 3 the *numerator* signifies the number of critical incidents identified in relation to the specific leisure task and the *denominator* signifies the total number of user study participants undertaking the specific leisure task.

Table 7.8: Examples of concrete leisure tasks and derived information needs.

Hob-by	Information related leisure tasks or interests	Examples of concrete leisure tasks or interests	Example of information needs derived from critical incidents
C	Build and maintain 'archives' related to objects in private collection (22 critical incidents)	Collector of hand weapons.	Information on wheel-lock gun from 1611 (participant E). Known item.
		Collector of hand weapons and edged weapons. Primarily interested in the period of the First and Second War of Schleswig.	Looking for weapons somewhat related to the period 1750 – 1864. Mostly pistols but also other firearms (participant R). Exploratory item.
C	Build and maintain repositories for a wider audience (5 critical incidents)	Contributing to building a (private) virtual museum on arms and armour	Verification of information on a dragoon pistol model 1741 (participant F). Known item.
C	Communication and knowledge sharing (1 critical incident).	Writing of article to journal published by the Danish Arms & Armour Society	Information on which hunting weapons were used and owned by King Christian the 10th (participant U). Muddled item.
P	Extend knowledge on historical firearms used for sport shooting (1 critical incident).	Collect information on different related pistol models	He uses a replica pistol for sport shooting and now he wants to see non-replica for details on two specific pistol models (participant Q). Known item.
L	Pursue general interest (3 critical incidents).	Pursue general interest in uniforms from 1700	Browsed through the museum's online exhibition on uniforms (participant X). Exploratory topical.
		Pursue interest in historical role-playing	Information on the development of edged weapons during the period 1200-1400 (participant K). Exploratory topical.
C/M/ A/P/L	Exploration of hobby or interest (7 critical incidents).	Pursue hobby or interest	Curiosity/ not looking for anything specific (participant B, N, Q, S, T, V, and Y). Exploratory information need.

Identified sub-tasks to each hobby type are shown in Table 7.7. The sub-tasks and derived information needs were primarily identified based on the user study participants' descriptions of their critical incidents. As explained in section 5.4.4 a critical incident was defined as an incident, whether interest or problem initiated, resulting in a visit to the Military Museum's web site the day the web survey was found and completed. All in all 39 critical incidents and derived information needs were identified (see Table 7.7) and they are discussed in the following.

The main leisure task of collectors' is focused on building, developing and maintaining their private collections. Three information related sub-tasks were identified. Firstly, all collectors in the user study build and maintain 'archives' to document and contextualise objects in their private collections. The term archive covers a variety of repositories, either paper or computer based, from few sheets of paper to extensive material collected through decades. 22 of the 39 information needs identified through the critical incident method relate to building and maintaining archives on objects in private collection. Of these, the majority (18) is known-item needs, 3 are exploratory item needs, and a single information need is categorized as known-topic. Sample citations expressing information needs are shown in Table 7.8 to illustrate the types of information needs.

'To build and maintain archives for a wider audience' is the second task type of collectors. The first and second tasks of collectors are similar, but in the second task type, the archive content is made available for a wider audience, for example by publishing it on the web. Five user study participants (participant A, F, I, J, and U) perform this second leisure task. Further, the case study shows that, where the first task type is initiated by the task performer themselves and performed in solitude, the second task type is both initiated and performed as a team effort. Finally, the interviews point to sharing and communicating information as an integrated part of being a collector. A single known-item information need related to information sharing is identified (see Table 7.7). Likewise a single known-item information need of a player of sports and games was identified.

As stated above, the main leisure task of liberal arts enthusiasts is to pursue their interest within defence and military history. This is in line with how Stebbins describes the developing of expertise as important and enjoyed by, especially, liberal arts enthusiasts, however, they do not necessarily further implement their knowledge. Instead they pursue knowledge for its own sake (Stebbins, 1994, p. 174). Two information related sub-task of this participant group are; 1) to pursue this leisure interest and 2) to share information related to the interest area (see Table 7.7). Three exploratory topical information needs are identified through the critical incident method related to liberal arts enthusiasts. Finally, seven highly exploratory information needs were identified, which cannot be confined to either hobby type or a more precise information need type. See Table 7.8 for examples.

The above description of participants' hobby areas, their leisure tasks and derived information needs identified from the critical incident method shows, that a leisure task is rarely assigned. Instead it is constructed intellectually by the actor. It is the interest and personal enrichment of the hobby that motivates and initiates the information seeking process. A parallel can be drawn to Erdelez's (1997) study of information encountering. She describes how information encountering is not necessarily problem-related but can also be interest-related.

To further understand participants' motivation for collecting objects and object-related information, they were asked to explain why they collect. Very telling, participant X[55] refers to the phrase "homo collecticus – the collecting man", and the following two quotes also reflect the appreciation of the objects:

> *"Never ask a collector, why he collects. He doesn't know. That is just the way it is. There is something fascinating about it."* (Participant O: line 35).

> *"I have collected objects since I was a small boy. I have also collected stamps. I have collected everything. […] Over the years I have changed focus and I have been interested in many things. I have collected English objects, Scottish and German objects – not 1939-45 – but the First World War and earlier. […] At one time, I collected objects from both the army and the marine, but that was too much. I had 350 caps, I had uniforms, 100 military decorations, badges and buttons, a collection of military photographs and other military papers and all sorts of things…"* (Participant M: line 23-24).

[55] Participant X: line 93.

Likewise, when asked how object-related information is used, the two following quotes show that the information is not necessarily further implemented but collected for its own sake:

> *"That is the awful part of it. I don't use it […]. The information is nice to have. I'm curious.*" (Participant S: line 82)
>
> *"Use? You mean, whether I write articles or so? No. It is stored on the computer. It is nice to know. […]. It is a way to satisfy my curiosity."* (Participant X: line 75-76).

The quotes illustrate how information seeking activities are not necessarily clear end-goal driven. Instead information may be collected for its own sake, that is, to pursue defence and military history or build and maintain knowledge related a private collection.

7.1.4 Summary and discussion concerning virtual museum visitors' leisure tasks or interests and derived information needs

The results on research question 2.a show a clear distinction between two primary groups of virtual museum visitors of the Military Museum's online catalogue. In general, using Booth's (1998) terminology, *user study participants are special interest museum visitors pursuing a long-standing interest or hobby*. Based on Stebbins's (1994) theoretical work on the serious leisure perspective and categorization of hobby types, participants are categorised as either *collectors* (the largest group) or *liberal art enthusiasts*. Although overlapping, the two hobby types have distinct profiles including the nature of knowledge acquisition.

Analysis shows how objects are collectors' primary interest, while the historical context is secondary. Collectors pursue technical information on the commercial, social, and physical circumstances in which items are acquired along with knowledge providing a broad understanding of items' historical and contemporary production and use. *Liberal arts enthusiasts*, on the other hand, define their hobby as a broader historical interest, while the objects are secondary. They seek broad and humanising knowledge. These differences are reflected in the web questionnaire data: significantly more collectors than liberal arts enthusiasts indicate an object-related primary purpose of visit whereas significantly more liberal arts enthusiasts indicate a more broad topical purpose of visit.

Across the two hobby types, the process of searching for hobby-related information encompasses much more than just casual searching the Internet or browsing books on the topic. In this regard, Savolainen's (1995) study concerning the role of 'way of life' in information seeking provides a useful framework for understanding participants' information seeking activities as an integrated component of everyday life. Participants' dedication, long-standing interests, and the often considerable time spent on the hobby indicate that their hobbies are integrated components of everyday practices.

The critical incident technique helped establish a relation between work tasks undertaken by participants of the two hobby types and derived information needs. Three work tasks of collectors were identified. The majority of information needs identified through collectors' descriptions of critical incidents were known-item needs. Only three critical incidents of liberal art enthusiasts were identified – all exploratory topical information needs. Summing up, given that hobbyists' information seeking behaviour is driven by interest and a clear end-goal may be lacking, the information needs identified were surprisingly well-defined. Based on our hypothesis on virtual museum visitors' exploratory information seeking behaviour, a higher percentage of ill-defined or muddled information needs reflecting exploratory and semantically open search tasks was expected. This said, the analysis also indicated results supporting an exploratory seeking behaviour. For example, 30% of the web questionnaire respondents were not looking for anything specific. Further, seven highly exploratory information needs were identified in the critical incidents, which cannot be confined to either hobby type or a more precise information need type. This is an interesting finding supporting an exploratory seeking behaviour. Unfortunately, data on the seven exploratory information needs was scarce.

The above findings stress the importance of not only looking at tasks as the motivating and initiating factor when studying information seeking behaviour in a leisure context. It is not necessarily a specific task which initiates a need for information. Accordingly, information seeking is not necessarily problem-related but is also interest-related.

Finally, the review in section 3.2.5 of virtual museum visitor studies confirms a link between online and in-person museum visits. The studies show that the primary purpose of a virtual museum visit is to support a visit to the physical museum (Booth, 1998;

Kravchyna, 2004; Thomas & Carey, 2005). The present study cannot confirm the findings of these studies. Instead, in line with findings of Goldman and Schaller (2004) the participants in the present study search for content rich information and exploration of museum resources. Further, as the main part of the respondents (70% - see section 5.4.2.3) can be described as *collectors*, the results reflect that the Military Museum's online catalogue at present primarily supports information needs and interests of collectors.

In continuation of the present section, the following section presents results on the relation between leisure tasks and preferred data elements. Again, the distinction between collectors and liberal arts enthusiasts is useful.

7.2 Preferred data elements in a searchable record of museum objects

This section answers research question 2.b on which data elements are preferred in a searchable record of museum objects and why. First, section 7.2.1 draws on empirical data on preferred data elements from the web questionnaire. Next, based on the user study participants' critical incident episodes, section 7.2.2 adds to the quantitative data and explores the relationship between types of leisure tasks and types of information needed in those tasks.

7.2.1 Web questionnaire data on preferred data elements

The visual, non-textual aspect of information seeking behaviour and virtual museum collections are emphasized by respondents, and accordingly 'photograph of object' is the most often indicated data element. Almost 90% of respondents say that 'photograph of object' is a relevant data element in a searchable record of a museum object. Table 7.9 shows frequencies for each of the 14 data elements listed in the web questionnaire. In general, respondents indicate a broad range of data elements and they are information-hungry as each respondent in average indicates 7.3 data elements as relevant to him.

The questionnaire data on preferred data elements were further explored by using chi-square tests to analyse differences between preferred data elements and the following three independent variables: 1) age, 2) knowledge level, and 3) type of hobbyists. In regard to the majority of data elements listed in the questionnaire, respondents from the two different age-groups do *not* differ significantly (see appendix 12). Only four data elements were indicated significantly more by the younger respondents (age 16 to 45) than by the older respondents (age 46 to 84):

- ‘When was the object used’;
- ‘In which countries was the object used’;
- ‘Historic information on periods or events associated to the object’, and
- ‘Long prose description of the object’.

This may indicate that the younger respondents are interested in and willing to go through more data online than the group of older respondents. Similarly, section 7.3.1 below shows how more younger respondents – more than older ones – use electronic sources.

In relation to knowledge level, no significantly differences in regard to preferred data elements were found between novices, respondents with some experience and highly experienced hobbyists (see appendix 13). Instead, the third independent variable, type of hobbyist, proved to show important differences. Significantly, chi-square tests showed (see appendix 14) that *collectors*, more than liberal arts enthusiasts, indicated data elements on factual, object related information (‘physical description and measurements of the object’, ‘production year’, and ‘production country’). Likewise, also significantly *collectors* indicated ‘photo of object’ and ‘references to further information on the object’ as relevant data elements (see appendix 14). These findings support our above characteristic of collectors as object centred with a primary focus on the commercial, social, and physical *circumstances of the objects* (see section 7.1.1). However, the assumption that liberal arts enthusiasts focus on broad and humanising knowledge was not justified by the questionnaire data. That is, there was no significant difference between the two hobby types with regard to associated historic context information (see appendix 14).

Based on the questionnaire data this section has described the frequency for each of the different types of data elements and analysed differences between preferred data elements and three independent variables. However, the questionnaire data does not provide a link between leisure task and derived information need *and* preferred data elements. Therefore, the following section builds on the critical incidents described in the interviews and simulated search task situations to explore the relation between types of leisure tasks and types of information needed in those tasks.

Table 7.9: Data from web survey on preferred data elements in a searchable record of museum objects (question 10, see appendix 4). Respondents were allowed to indicate more than one answer (n = 132).

What type of information on a museum object is relevant to you?	#	%
Factual, object related information:		
Physical description and measurements of the object	86	65.2
Production year	91	68.9
Type of object	68	51.5
Country of production	68	51.5
Visual:		
Photograph of object	118	89.4
Provenience:		
Who owned and/or used the object	65	49.2
When was the object used	86	65.2
In which countries was the object used	65	49.2
Associated historic context information:		
In which historic events was the object used	70	53.0
Historic information on periods or events associated to the object	46	34.8
Other:		
Short prose description of the object	38	28.8
Long prose description of the object	75	56.8
References to further information on the object	73	55.3
Other	15	11.4
I don’t know	2	1.5

7.2.2 The relation between types of leisure tasks and types of information needed in those tasks

Collectors and liberal arts enthusiasts cover two rather different approaches to the hobby of defence and military history (see section 7.1.1). This section shows how *collectors* in their leisure tasks mainly need object-related information, photographs, and provenience information. In contrast, *liberal arts enthusiasts* need various types of information including associated historic context information and references to further information.

When user study participants described the critical incidents including their leisure tasks and derived information needs resulting in visiting the Military Museum's online catalogue, they were asked also to describe which data elements were important to them in this particular case. Table 7.10 summarises the relation between types of leisure tasks and preferred data elements. Thus, Table 7.10 is an extension of Table 7.7 which shows the relation between leisure task and derived information needs.

'To build and maintain archives related to objects in private collection' is the most frequent identified leisure task described in the critical incidents. That is, 22 of the 39 identified critical incidents relate to this task and from Table 7.7 we learn that the majority (18) of the derived information needs are known item information needs. Table 7.10 shows how participants, in this task, needed factual object related information (mentioned 20 times), followed by photograph (mentioned 13 times), and provenience information (mentioned 12 times). The two other leisure tasks of collectors ('build and maintain repositories for a wider audience' and 'communication and knowledge sharing') follow the same pattern: data elements covering factual object related information, photograph, and provenience information are preferred.

Three critical incidents are identified in relation to leisure tasks (pursue interest) of *liberal arts enthusiasts* and they all cover exploratory topical information needs (see Table 7.7). Table 7.10 shows how participants in this task looked for various types of data elements including associated historic context information and references to further information. In the critical incidents in general, the 'other' category covered primarily references to other objects or references to more information related to the object.

Finally, as explained in section 7.1.3 seven critical incidents reflecting highly exploratory information needs or interests were identified, which cannot be confined to either hobby type or a more precise leisure task than 'exploration of hobby or interest'. The seven participants all remembered their visit to the museum's web site and how they filled in the web questionnaire, however, they were unable to be specific about what they were looking for or useful data elements. Except participant T and V who both pointed to photographs as the most useful and important data element.

Table 7.10: Relation between types of leisure tasks and data elements. Data derived from participants' description of critical incidents.

Hob-by	Type of information → Information related leisure tasks or interest ↓	Factual, object related info.	Photo-graph	Prove-nience info.	Associated historic context info.	Other
C	Build and maintain 'archives' related to objects in private collection (22 critical incidents).	20	13	12	2	2
C	Build and maintain repositories for a wider audience (5 critical incidents).	3	3	3	-	2
C	Communication and knowledge sharing (1 critical incident).	1	1	1	-	-
P	Extend knowledge on historical firearms used for sport shooting (1 critical incident).	-	1	-	-	-
L	Pursue hobby or interest (3 critical incidents).	3	3	3	3	3
C/M/ A/P/L	Exploration of hobby or interest (7 critical incidents).	-	2	-	-	-
All	Across all leisure tasks (39 critical incidents)	27	23	19	5	7

In addition to the data from the web questionnaire and from the descriptions of critical incidents, also the simulated search task situations provided information on preferred data elements. During the retrospective talk-aloud sessions participants were asked to mention the most useful/important data elements (if any) for each of the four simulated search tasks. The results are shown in Table 7.11 and confirm the results from the critical incidents. In task B and D, which reflect known data element and known item information needs, factual and object related information is the most useful/important information type followed by photograph and provenience information. In task C, an ill-defined and open topical information need, factual and object related is not very important. Instead provenience information describing the use of a particular object, thus linking the object to a historic context, together with associated historic context information are indicated as preferred data elements. Finally, task A is different from the three other tasks. In this topical task, a photograph depicting a ’purchased’ powder horn is given to the participant. Accordingly, the visual aspect is dominant in this specific task and all 24 participants point to ‘photograph’ as an important data element, both when browsing through the search results and when deciding on the use of the powder horn. See also section 7.4.2.1 on the highly visual oriented searching behaviour of virtual museum visitors.

Table 7.11: Relation between simulated search tasks and preferred data elements.

Type of information → **Task ↓**	Factual, object related info.	Photograph	Provenience information	Associated historic context info.	Other
Task A – powder horn Well-defined topical info. need	1	24	6	0	0
Task B – gun makers Known data element	12	5	3	0	0
Task C – the Second World War Ill-defined topical info. need	3	5	10	4	4
Task D – Colt Navy Known item + data element	15	8	5	2	2
Total	31	42	24	6	6

Further results from the simulated search task situations illustrating characteristics of participants’ searching behaviour are described in section 7.4. First, the following section summarises and discusses the results regarding preferred data elements.

7.2.3 Summary and discussion concerning preferred data elements

This section summarises the results that compose the answers to research question 2.b concerning: which data elements are preferred in a searchable record of museum artefacts and why. The results from the web questionnaire show that a wide range of data elements is considered useful. ‘Photograph of museum object’ is the most often mentioned data element, which stresses the strong visual aspect of searching virtual museum collections. In comparison, findings by Tombros et al. (2005) related to importance of web document features across three different tasks showed that picture was only the fourth most often mentioned feature. Content, numbers, and layout were more often mentioned. Further, the results show how *collectors* mainly need factual, object-related information, photographs, and provenience information in their leisure tasks. Whereas *liberal arts enthusiasts* need various types of information including associated historic context information and references to further information. The findings confirm Stebbins's (1994, p. 175) proposal that *collectors* seek specific and technical knowledge. In relation to *liberal arts enthusiasts* on the other hand, the questionnaire data did not significantly reflect that they seek broad and humanising knowledge.

The relation between preferred data elements and type of leisure task is illustrated in figure Figure 7.1 below. The horizontal axis illustrate a continuum of types of information ranging from closely object related information (also including photograph) over provenience information (describing the use of a particular object, and thus linking the object to a historic context) to associated historical context information. The dotted, vertical axis illustrates virtual museum visitors' knowledge level. It is a hypothesis that virtual visitors with low and high knowledge level, respectively, as to defence and military history need different types of data presented differently. However, the present study could not investigate this hypothesis, as none of the user study participants were novices. Therefore the vertical axis is dotted.

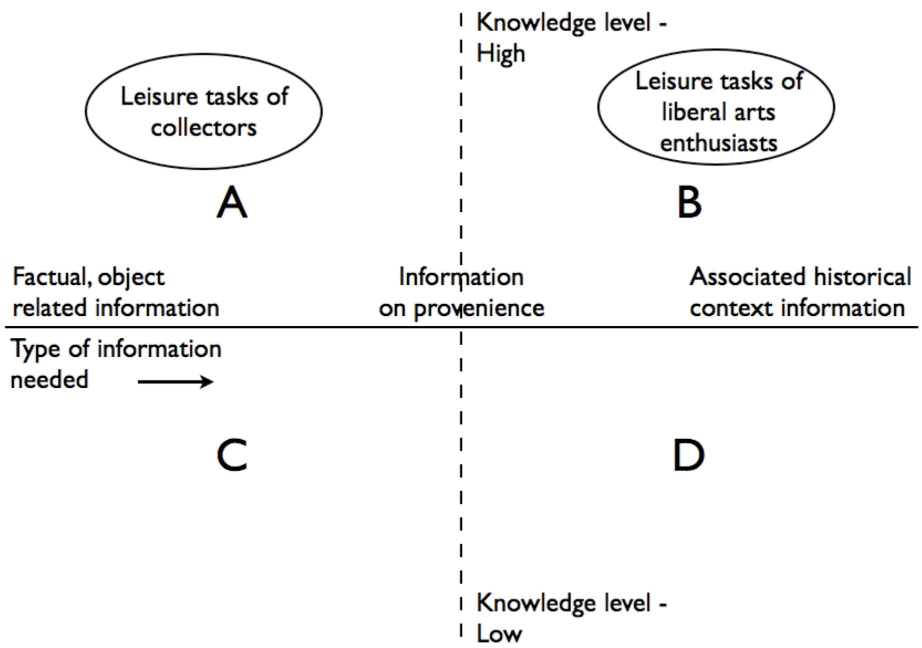

Figure 7.1: Illustration of relation between preferred data elements and type of leisure task.

The same pattern between preferred data elements and types of leisure tasks was identified through different data collection methods, which provides confirmation and validation of the results. With the chosen data collection approach, it was difficult to extract information on preferred data elements in relation to the exploratory, ill-defined information needs described in the critical incidents. The same problem was encountered in relation to gaining an insight into the characteristics of these exploratory, ill-defined information needs.

Finally, as discussed in section 3.1.3, several earlier studies (Chaudhry & Jiun, 2005; Orna & Pettit, 1998; Stephenson, 1999, Trant 2006) report on a mismatch between museum documentation and user needs. According to theses studies the mismatch can largely can be explained by a highly specialist and internal perspective on resource description in museums. Results from the present study concerning preferred data elements *do not* support the findings from the aforementioned studies. In general, participants reported on no problems related to, e.g., understanding the specialist terminology used in the online catalogue. The user study participants' high level of experience and long-standing hobby interests are probably the main explanations of why no mismatch is identified in present study. This said, two aspects identified in the retrospective talk-aloud sessions call for (additional) *mediated information* (to use the terminology introduced in section 3.2.2). Firstly, during simulated search task B, participant V[56] misses explanatory information on the different types of weapons, for instance, what is a 'percussion rifle'? Likewise, participants G[57] and X[58] would like to se more links to external written sources in order to see more information about the associated historical context. The two examples illustrate the few calls by user study participants for more mediated information to complement the primarily *refined information* in the Military Museum's online catalogue.

Vakkari (2000b) has noted that by identifying what users expect from document representations, we can design more suitable representations. By answering research question 2.b this study may provide suggestions as to which data elements in a searchable museum record are used in which leisure tasks and thereby assist planning of digitization efforts.

[56] Participant V: line 82.

[57] Participant G: line 210

[58] Participant X: line 153

7.3 Virtual museum visitors' use of information channels and sources

This section covers research question 2.c on which information channels and sources are used in what kinds of leisure tasks. In this study, information channels are understood as a medium, which provides access to the information source, while the information source contains the information (see also section 6.3.1). In relation to virtual museum visitors, information channels were divided into three overall types: personal channels, written non-electronic channels, and electronic channels. The first channel covers all communication forms that involve interaction between persons, such as face-to-face or telephone conversations, meetings, and e-mails. The second channel is written, non-electronic channels covering external channels like public libraries, special and/or research libraries, and archives as well as internal sources like participants' own book collection. The third channel covers various electronic channels (documentary programs on TV or DVD, discussion groups and/or mailing lists, blogs, and the Internet in general).

Virtual museum visitors' use of information channels and sources are discussed by drawing on two empirical data sources. First, section 7.3.1 describes the empirical data from the web questionnaire related to information sources and channels. Next, section 7.3.2 relates types of tasks to types of information sources. Finally, section 7.3.3 shows how the Military Museum is seen as unique source of information on authentic, historic objects.

7.3.1 Web questionnaire data on information channels and sources

From the web questionnaire survey we learn that respondents use a variety of information sources and channels when pursuing their defence and military history hobby. On average each of the 132 respondents indicated 3.9 information sources. The most often mentioned source is 'people who share the same hobby or interest area', followed by 'the Internet in general' and 'own book collection' (see Table 7.12).

Table 7.12: Data from web survey on information sources and channels (question 6, see appendix 4). Respondents were allowed to indicate more than one answer (n = 132).

Where do you find information related to your hobby?	#	%
Personal channels:		
Family and friends	20	15.2
Other people who share the same hobby or interest area	100	75.8
Written, non-electronic channels:		
Public libraries	34	25.8
Special libraries and/or research libraries	47	35.6
Archives	32	24.2
Own book collection	71	53.8
Electronic channels:		
Documentary programs on TV or DVD	37	28.0
Discussion groups and/or mailing lists on the internet	53	40.2
Blogs	13	9.8
The Internet in general	89	67.4
Other:		
Other	15	11.4
I don't know	2	1.5

Like in section 7.2.1, chi-square tests were used to further explore differences between use of sources and the following three independent variables: 1) age, 2) knowledge level, and 3) type of hobbyists. The chi-square tests (see appendix 15) revealed a weaker tendency that 'family and friends' and electronic sources[59] ('discussion groups', 'blogs', and 'the internet in general') are used more by the group of younger respondents (age 16 to 45) than by the group of older respondents (age 46 to 84). On the other hand, the group of older respondents uses significantly more 'special and/or research libraries' and their 'own book collection', than do younger respondents (see appendix 15). Together with archives, respondents with extensive experience likewise use these last two sources significantly more than do novices (see appendix 16). Novices, in contrast,

[59] A distinction between known, personal contacts and more anonymous (virtual) contacts have been applied in the categorisation of sources and channels. Active use of a mailing list or discussion group, however, can also be considered a social/personal channels, but are not categorised as such in the present context.

use 'the Internet in general' significantly more than do respondents with extensive experience (see appendix 16). No differences were found between respondents with different knowledge levels in regard to the remaining sources.

Finally, only one single significant difference between the two types of hobbyists (collectors and liberal arts enthusiasts) and types of sources used were found (see appendix 17). That is, blogs as an information source are used significantly more by liberal arts enthusiasts than collectors. In general it indicates that the sources listed in the web questionnaire are equally relevant to and used by both types of hobbyists.
Based on the interviews in the user study, the following section relates use of information sources and channels to leisure tasks.

7.3.2 Relation between use of information sources and leisure tasks

In the post-search interviews participants were asked to describe their hobby-related use of information channels and sources, both in general and as part of their description of critical incidents. Table 7.13 shows the distribution of information sources consulted in the 39 critical incidents across leisure tasks. A critical incident can result in more than one type of information channel used. The Military Museum's online catalogue is used

Table 7.13: Relation between leisure task and types of information channels and sources used.

Hobby	Information related leisure tasks or interest	Types of information channels and sources used: The Mil. Museum's online cat.	Personal	Written, printed media	Electronic media	Other
Collectors	Build and maintain 'archives' related to objects in private collection (22 critical incidents)	(22)	Other hobbyists (4)	Public library (1) Own book collection (6)	Internet (5)	Other museum (1)
Collectors	Build and maintain repositories for a wider audience (5 critical incidents)	(5)	Other hobbyists (2)	-	Internet (2)	-
Collectors	Communication and knowledge sharing (1 critical incidents)	(1)	Other hobbyists (1)	-	-	Other museum (1)
Players of sports and games	Extend knowledge on historical firearms used for sport shooting (1 critical incidents)	(1)	-	-	Internet (1)	-
Lib. arts enthusiasts	Pursue hobby or interest (3 critical incidents)	(3)	Other hobbyists (2)	Special libraries (2) Own book collection (2)	Discussion groups (2) Internet (2)	-
C/M/A/P/L	Pursue hobby or interest (7 critical incidents)	(7)	-	-	Internet (3)	-
Sum	39 critical incidents are identified across tasks	(39)	9	11	15	2

in all critical incidents. This is obvious as a critical incident was defined as the trigger of an information need or interest resulting in a virtual visit to the Military Museum's online catalogue. In 12 (31%) of the 39 critical incidents identified, the Military Museum's online catalogue was the only information source used.

The three most often mentioned information sources are 'the Internet', 'own book collection', and 'other hobbyists', and thus support the results from the questionnaire, which identified the same three top-frequent sources. Further, based on the relatively few critical incidents *no clear relation* was found between type of information sources used and leisure tasks. That is, the critical incidents show that, e.g., 'the Internet' and personal channels like 'other hobbyists' are used across leisure tasks of collectors and liberal arts enthusiasts. Again, this supports the findings from the web questionnaire, which showed that the sources listed in the web questionnaire were equally relevant to and used by both types of hobbyists.

The critical incidents did not reveal patterns between use of information sources and task types. However, the participants' descriptions of critical incidents together with their descriptions of information sources used in general (in relation to hobby) did provide valuable input to the characteristic of information seeking behaviour of virtual museum visitors. Main findings related to types of sources used are described in the following.

The interviews reflect that *personal channels* and the social context of a hobby are highly important to user study participants. Hobby-related discussions with peers are often mentioned, and participants recognised the situation described in simulated work task A, where a discussion on the use of a purchased powder horn leads to an information seeking episode. To give an example, participant A explains how rewarding discussions with peers are to him:

> *"We can talk for hours. For example, an acquaintance of mine bought a pistol, a flint lock pistol, in a very poor condition. We have discussed this pistol for hours because it is atypical. What if…? Could it be…? Now that I have cleaned it, I can see that… It is wonderful to have these conversations. It is the fun part of it. It is much more fun than actually having the objects"* (participant A: line 88).

Communication through personal channels takes place either face-to-face, by telephone or e-mail. It is mainly based on informal contacts. However, also more formalised personal contacts are mentioned like membership of different associations related to defence and military history. Participation in these formalised organisations is often restricted according to individual interest areas. Participants selectively choose to attend meetings, lectures, or trips based on what specifically relates to their interest areas[60]. A parallel can be drawn to Butterworth and Perkin's (2006) study of non-professional information use of personal history researchers. Their study describes personal history researchers' participation in organisations (e.g., family and local history research groups) as sporadic and boundaries between organisations as ill defined.

In relation to *written, non-electronic channels* participants' private book collections are the most frequent used source supplemented with occasional use of books from special or public libraries. Therefore it was not surprising to observe extensive book collections in both cases where interviews took place in participants' private homes. Also, the critical incidents (see Table 7.13) illustrate how either personal contacts or participants' book collections were used as alternative sources if the information needs could not be resolved based on information from the Military Museum's online catalogue. Four of the participants explicitly explained how they preferred books to the Internet because of general low quality content on web sites related to their interest areas.

The internet as an information source was, however, the most often indicated *electronic information channel* and all participants use the internet for both seeking and giving hobby related information. The interviews reflect how participants are prepared to put a *considerable effort* into locating, searching and extracting information from Internet sources. For example, participants L and U use web sites in languages, e.g. Russian and Spanish, they do not know in order to explore their interest area. Supported by visual data elements, dictionaries, and online language translation tools like Babel Fish[61] they are able to extract relevant information. Likewise, participants K, P, T, and R explain how they daily or weekly scan selected web sites of auction houses,

[60] Participant A: line 67 and participant O: line 69.

[61] The Babel Fish online language translation tool can translate, e.g., Russian, Spanish, French and Japanese into English (but not Danish) and vice versa. Babel Fish can be found here: http://babelfish.yahoo.com/

discussion groups and hobby web sites to keep up to date. Finally, in relation to discussion groups and mailing lists on the Internet many of the participants put considerable effort into reading, writing and answering others posts. A good example is participant Y, who is member of an American mailing list on military history:

> *"… I'm a member of this mailing list. It is an academic mailing list but we are some amateurs who have been accepted to join the list […]. Primarily, I read German research literature but many of the American and British members of the list do not read German and are therefore rather ignorant… or they have a rather romantic picture of the German army […]. However, I do not write postings on the mailing list as often as I used to anymore because sometimes it has taken me several days to write a posting. You have to include references and so on. So now I mostly read the mailing list"* (Participant Y: line 61)

In general the participants are critical towards information located on, e.g., Wikipedia or via Google and use more than one source to verify information. In relation to trustworthiness of information and dilemmas of digitization, the following section discusses participants' view on the Military Museum as an information provider.

7.3.3 The Military Museum as an unique information source

The first of the three dilemmas of digitization in cultural heritage, discussed in section 3.2.1, is *the dilemma of representation*. It centres on the status between the original museum object and the copy. In this case the copy is the digital representation of the museum object in the online museum catalogue. The interviews reflect that the original museum object exhibited in the physical museum *does* represent something unique which cannot be replaced by a virtual reproduction[62]. For example, participant E comments:

> *"The online catalogue is a fantastic supplement, but to a collector it is very special to be able to press your nose against the glass in the exhibition case, or preferable to be allowed to enter the storage. It is just different."* (Participant E: line 114).

[62] Participant O: line 104, participant P: line 77, participant R: line 85, participant U: line 102, and participant X: line 83.

Likewise, participants B and E harmfully comment on the Military Museum's plans for the change or reduction of the present permanent exhibition:

> *"It is crazy. Imagine that you visit the Tate Gallery or the National Portrait Gallery and ask to see this and this painting and then you get the answer that you can see the paintings on a screen. Or what about the Mona Lisa painting at Louvre? People come from all over the world to see these items."* (Participant B: line 81).

The above quotes do not indicate reluctance towards the Military Museum's digitization project, but rather that the online catalogue complements the exhibition in the physical museum. Accordingly, several participants point to advantages of the online catalogue, such as the possibility to zoom and view details[63], flexible and easy access from your private home[64], and animations of how objects work as well as photographs of objects in context[65]. Thus, this study supports findings by Thomas and Carey (2005) and Kravchyna (2004) indicating that virtual representation of museum collections does not jeopardize museum visitation. Instead the physical and virtual museums are complementary.

The second dilemma, *the authority dilemma*, relates to how digitization potentially blurs the boundaries between the museum and the public. In general participants view the Military Museum as an unique and highly authoritative source of information on authentic, historic objects. This is stressed by how participants use the online catalogue in the critical incidents and associated leisure tasks described in section 7.1, e.g., to verify information on objects in participants' private collections or use information and photographs as input to building and maintaining repositories for a wider audience. Especially the original registration materials are viewed as a primary, rich source of unique information[66].

However, two aspects related to opening up museum databases to end users can potentially be seen to blur the boundaries between the Military Museum and its visitors.

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[63] Participant V: line 89 and participant X: line 99.

[64] Participant E: line 114 and participant N: line 44

[65] Participant X: line 83.

[66] Participant C: line 110, participant F: line 137, participant L: line 223.

Firstly, object information and photographs are virtually disseminated and re-used in new contexts, for instance, in relation to leisure tasks on building private archives, repositories for a wider audience, or publishing articles. Accordingly, the museum professionals' lose control over the context in which museum objects and information are used (Marty et al., 2003, p. 281). Secondly, the interviews show how the opening up of internal documentation to end-users has also resulted in a beginning critical voice. Participants F, J, L, and R explicitly discuss and question the correctness and completeness of parts of information in the online catalogue:

> *"A person, who does not know these objects, is looking at two different labels which are both wrong […]. The online catalogue is an excellent project but it is just so important that the information is correct. It is an official web site. I collect these Enfields and therefore I know these things, but otherwise I would not. When it comes to older percussion or flintlock weapons, I don't know anything. It is a new area to me and therefore I have to trust that the information is correct."* (Participant J: line 97).

Likewise, participant R comments the incompleteness of data:

> *"In my view, the scanned registration material appears old. Today they appear incomplete. First and foremost I would like to know the production number and maybe producers; however, I do realise that you cannot include everything."* (Participant R: line 32).

Finally, only a single aspect relates to the third *dilemma between access and disneyfication* was identified in the interviews. It concerns how information seeking is not necessarily purposive and goal driven. This aspect is further discussed in section 7.4.2 on virtual museum visitors' searching behaviour.

7.3.4 Summary and discussion concerning information channels and sources

The present section summarises and discusses the results that compose the answer to research question 2.c on which information channels and sources are used in what kinds of leisure tasks.

Results from the web questionnaire show that respondents use a variety of information sources. The most often mentioned source was 'people who share the same hobby or interest area', followed by 'the internet in general' and 'own book collection'.

Statistical analysis of the questionnaire data revealed differences between the groups of younger and older participants, and between the groups of novices and experts. In general, younger participants relied more 'family and friends' and electronic resources whereas the group of older respondents relied more on 'special and/or research libraries' and their 'own book collection'. Together with archives, respondents with extensive experience likewise use these last two sources significantly more than do novices. One may argue that it takes an effort and requires at least some background knowledge of the area to use research libraries and archives and to build a book collection. Highly dedicated hobbyists are probably willing to pay that effort. In contrast, Internet resources are easily accessible. Thus, it is not surprising, that novices significantly more use 'the Internet in general' than do respondents with extensive experience.

Based on the 39 critical incidents described in the interviews it was not possible to identify patterns between use of information sources and leisure tasks. This suggests that the listed information sources are used across different types of leisure tasks of both collectors and liberal arts enthusiasts. In relation to information sources, the interviews confirm and validate the findings of the web questionnaire.

Even though a pattern could not be recognised between sources and leisure tasks, participants' description of use of information sources and channels in the critical incidents did provide valuable insight and added to the characteristic of virtual museum visitors' information seeking behaviour. Participants stressed the importance of *personal channels* and the social context of the hobby. A parallel can be drawn to information seeking studies of non-professionals' use of archives demonstrating how family historians rely heavily on social networks and personal channels (Duff & Johnson, 2003; Yakel, 2004). In relation to *electronic information channels*, all participants used 'the internet in general' in order to explore their hobby. The interviews show how participants are willing to put a considerable effort into locating, searching, and extracting information. However, participants are critical towards information found on the internet and prefer to verify information through different sources. Hence, the present study supports findings by Flanagin and Metzger (2001) and Hektor (2003) that the internet is used broadly for both seeking and giving information yet is most often a complement to or substitute for other sources, not a unique source.

Finally, the interviews show participants view on the Military Museum as a content provider and the dilemmas of representation and authority are discussed. The results show that the physical and virtual museums are complementary. Original museum objects exhibited in the physical museum *do* represent something unique which cannot be replaced by a virtual reproduction. On the other hand, the online catalogue provides 1) new features (e.g., zoom function and the possibility to browse historical eras), 2) access to information not previously accessible to museum visitors, and 3) convenient and flexible access. In general, despite the previous identified shortcomings of the museum's documentation, the Military Museum's online collections are viewed as an unique and authoritative source of information mainly because of its authentic objects.

7.4 Characteristics of searching behaviour of virtual museum visitors

This section answers research question 2.d concerning: what characterises searching behaviour of virtual museum visitors, with focus on how different task types affect search attributes and search strategies. First, section 7.4.1 analyses how different types of search tasks affect search attributes and search strategy. Secondly, section 7.4.2 suggests and discusses a model of four main characteristics of virtual museum visitors' searching behaviour.

7.4.1 How task type affect search attributes and search strategy

Borlund's (2000b) evaluation framework for interactive information retrieval systems was applied to investigate how different task types affect search attributes and search strategy. The 24 user study participants each conducted four simulated search tasks (see full wording of tasks in Figure 5.5). Tasks were coded on six quantitative search attribute dimensions and two search strategy dimensions shown in Table 7.14. To exemplify, the attributes concerning task A are explained in the following. User study participants spent on average 04:58 minutes to complete task A, viewed 29.71 items in the search result list (without opening), viewed (opened) 2.04 records, viewed 0.71 large photographs, used the zoom function 0.42 times, viewed the scanned registration material 0.79 times, and made 1.42 search iterations. Further, the main search strategy applied in task A was free text searching combined with direct browsing (using Marchionini's (1995) terminology), in the form of scanning of search results.

Table 7.14: How type of search task affects search attributes and search strategy (n = 24)

Search attributes of simulated search tasks:	**Task A** Powder horn	**Task B** Gun makers	**Task C** 2nd WW	**Task D** Colt
Average search time (minutes)	04:58	05:07	07:31	05:31
Average number of items viewed in the search result list	29.71	10.29	28.88	29.54
Average number of records viewed	2.04	3.58	2.88	2.33
Average number of large photographs viewed	0.71	0.38	1.25	0.83
Average number of times the zoom function is used	0.42	0.17	0.54	0.25
Average number of registration material viewed	0.79	2.21	1.75	1.63
Average number of search iterations	1.42	1.38	0.58	0.79
Search strategy:				
Main search strategy applied:	Free text searching	Free text searching	Browse historical periods	Free text searching
Type of browsing:	Direct browsing of search results	Direct browsing of search results	Semi-direct browsing	Direct browsing of search results

In order to *explore* the quantitative data an one-way ANOVA test (level of significance of 0.05) was carried out to analyse differences among the four search tasks in relation to the selected search attributes. The ANOVA test was carried out according to the following overall hypotheses:

H*o*: no difference exists between the different types of search tasks

H*a*: difference exists between the different types of search tasks

Results of the ANOVA test show a strong association between task type and ‘number of items viewed in the search result list’ (see appendix 18). The post hoc multiple comparisons test (the LSD test) showed that the number of items viewed in the search result list is significantly lower in task B than the other three tasks. This is not surprising since task B represents a known data element search and most participants searched for the name of the town 'Odense' resulting in a result comprising only 7 items.

A weaker association was found between task type and the following three attributes: 'average search time', 'average number of registration material viewed', and 'average number of search iterations' (see appendix 18). Firstly, concerning 'average search time', participants spent significant longer time on the semantically open and ill-defined search task C than the other three tasks. Even though participants spent longer time on this task, they did not open significant more records than in the other tasks (see below). Task C is a good example of how participants heavily browsed the search result lists and used the thumbnail images of photographs to assist them in gaining an overview of the results. For example, participant J spent 8½ minutes on task C and opened only a single record. The results indicate an association between task and 'average search time': more time is spent on semantically open topical search tasks.

Secondly, on average a lower number of *registration material* was viewed during search task A (powder horn) than in the other tasks. The scanned copy of the original registration material contains additional information on physical object description, provenience, etc. However, the answer to task A can be found without consulting the registration material which explains the low number of average material viewed in this task. Thirdly, participants made fewer search iterations in task C and D than in task A and B. As explained below, the main search strategy applied in task C was browsing, and hence a low number of search iterations were to be expected in this task. In task D most participants applied a single search term, 'colt' or colt navy', also resulting in few search iterations.

The statistical tests showed no patterns of differences concerning task types and the following three attributes: 'number of records viewed', 'number of large photographs viewed', and 'number of times zoom function used' (see appendix 18). Consequently, we fail to reject the null-hypothesis concerning these three attributes.

A clear association was found between search strategy and type of information need. In the three simulated search tasks representing well-defined information needs (task A, B, and D) the main search strategy applied was free text searching. Especially in task D (Colt Navy) free text searching was combined with use of the drop-down menus to limit the query by 'country of production' or 'object type'. In these three tasks participants also used a *directed browsing* strategy. As described by Marchionini (1995) directed browsing was conducted in the form of scanning the result lists to compare well-defined sets of objects.

In the semantically open and ill-defined task C, on the other hand, the main search strategy applied was browsing of historical eras to explore the Military Museum's collections related to the Second World War. Compared with the other three tasks, participant applied a less systematically semi-directed browsing when examining records. However, instead of browsing five participants (B, K, L, R, and S) chose to apply rather specific free text queries in task C. For instance, a search on the 'Madsen machine gun' related to the Second World War. Ingwersen and Järvelin (2005, p. 293) explain how the searcher may very well seek for known items – avoiding topical searching – feeling the former as easier. Hence, a known item search function as a starting point for finding 'something topically similar or content-like' with respect to the found item. The example shows how transition between the different information needs types is continuous (see section 4.4)

No statistical tests were conducted concerning search strategy and type of information need, as a clear distinction was identified between task C and the other three tasks.

7.4.2 Model of virtual museum visitors' searching behaviour

Four main characteristics of virtual museum visitors' searching behaviour are identified based on observations of participants' searching behaviour during the simulated search tasks sessions coupled with an analysis of participants' explanations and comments related to the search sessions. The four characteristics are: 1) highly visual experience, 2) exploratory behaviour, 3) broad know item/element search, and 4) meaning making. The four characteristics are illustrated in Figure 7.2 and are elaborated in the following four sub-sections. An earlier version of the figure was published in Skov and Ingwersen (2008).

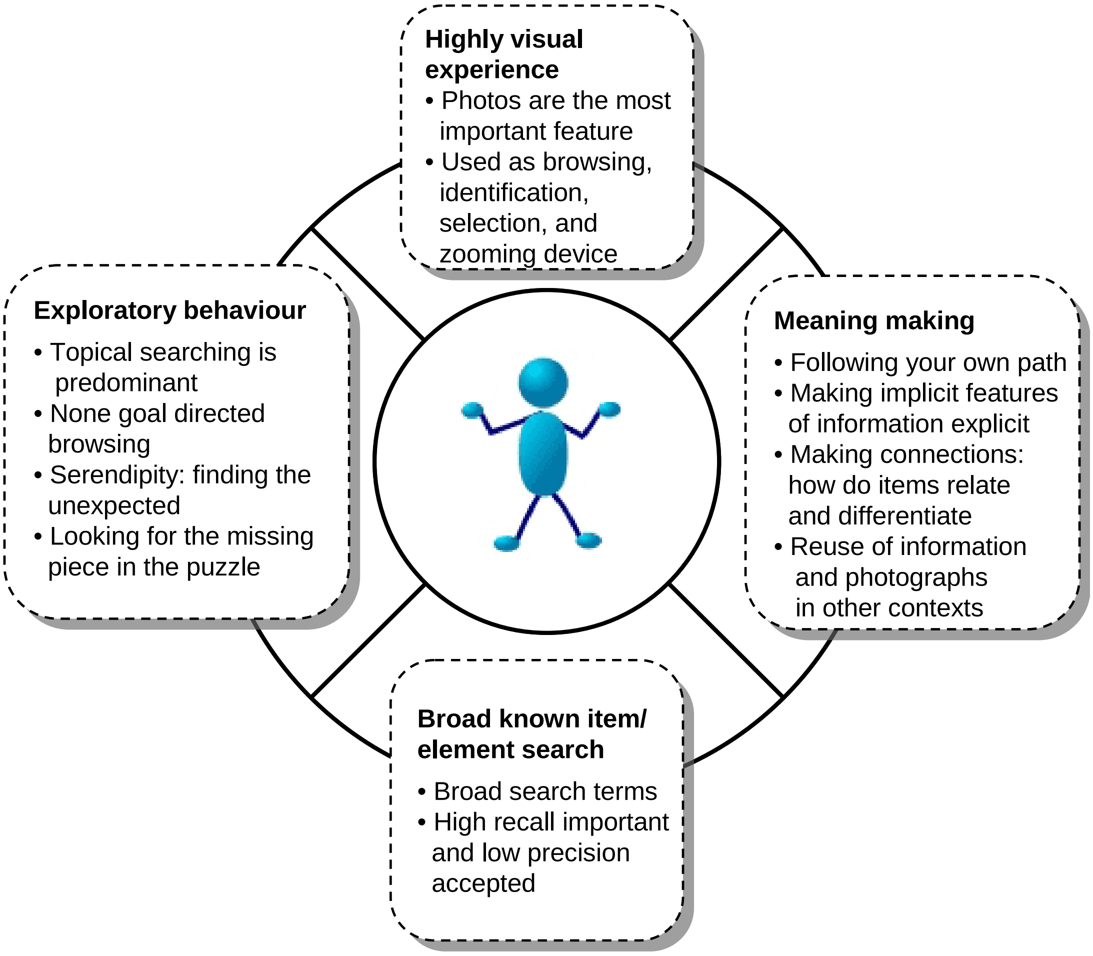

Figure 7.2: Characteristics of virtual museum visitors' searching behaviour

7.4.2.1 Highly visual experience

Participants' searching behaviour has a strong visual aspect which is confirmed by findings on preferred data elements. 'Photograph of museum object' is the most often indicated preferred data element (see section 7.2). The photographs in the online catalogue were used as browsing, identification, selection, and zooming device. The following provides some examples.

Firstly, the thumbnail images of photographs shown in the result lists is an important feature which support participants when browsing the result lists and choosing which records to open (see example of a result list in appendix 4):

> *"It is really nice. The photograph in the result list helps you to deselect many items."* (Participant S: line 94).

> *"It [thumbnail images in the result list] is a good thing. Especially when I know something about the items because then I can quickly go through the list and find what I need."* (Participant M: line 148).

Thumbnail images in the result list are also used during browsing to gain an overview of the search result[67]. The visual aspect is especially important in simulated search task A, where a photograph of a 'purchased' powder horn was shown to the participants. Comparing this photograph with the thumbnail images in the result list helps to decide which museum objects resemble the 'purchased' item (Participant D, F, I, Q, V and Y).

Finally, large photographs and the zoom function provide details[68] and are most often used in the ill-defined topical search task C on the Second World War.

7.4.2.2 Exploratory aspects of searching behaviour

This subsection addresses characteristics relating to an *exploratory searching behaviour* of virtual museum visitors which is predominantly in topical searching. The section is a direct continuation of the previous sub-section, since the visual aspects of searching behaviour supports exploratory behaviour.

Different aspects of exploratory searching behaviour were identified across task types. The most significant was *information encountering* as described by Erdelez (1997; 2000) or the strongly related aspect of serendipity (see section 4.4.2). Quotes from, e.g., participants A and M illustrate how participants recognise the accidental encountering of information during browsing or an active search for some other information:

> *"You might see hundred 'gravkors' [a type of sword] which all have an often seen mark from, e.g., the 5th or the 7th battalion. But then you see one with an absolutely crazy mark which no one can explain. And that is the fun part of it […]".* (Participant A: line 164).

Likewise, participant M talks about looking for the missing piece in the puzzle:

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[67] Participant H: line 129.

[68] Participant L: line 172, and participant O: line 145.

> *"In the old catalogue cards you might all of a sudden find a small, specific piece of information that you have been looking for in years. Ok – that's the way it is."* (Participant M: line 146).

Another aspect signifying an exploratory approach to information seeking is how participants choose which records to open. For example, during the semantically open and ill-defined topical search task C (the Second World War), participants were asked how they decided which records to open from the search result list. Their answers can be grouped into two categories. Either they pursued an item already known to them to see if the museum records verified information already familiar to them. Or participants[69] followed items that somehow differentiated from the other items in the result list or caused surprise. The latter signifies an exploratory approach.

Based on the above, the following three elements were identified to support accidental or serendipitous discoveries:

- Photographs were used to support browsing. Especially, photographs which showed the context of the object, e.g., how an object was used or showed an object together with related accessories, were useful. At the time of the user study (February - April, 2008) only few such photographs were included in the online catalogue. However, there was a clear demand for these context rich photographs and the Military Museum has many such photographs in their collections.
- References from one object to another related object allowed users to discover new associations. At the time of the user study (February - April, 2008) only few such references existed in the online catalogue. However, there was a clear demand for these references.
- Two ways in: the online catalogue has both a topical entry, supporting browsing through historical eras (see Figure 5.3), and a query search entry (see Figure 5.4). Both entries provide access to the same records of museum objects, but in different ways. Hence, different structures of the information space also support information encountering.

[69] E.g., participant J: line 122 and 132, participant K: line 197, participant L: line 326, participant P: line 164, and participant Q: line 94 and 243.

The three elements give specific examples of how characteristics of information seeking behaviour can be related to the information space.

In relation to Bates's (1989) *berrypicking* model, suggesting searchers behaviour in interactive IR systems to be evolving, the simulated search task situations provided only little supportive data. According to the berrypicking model each new piece of information a searcher encounter gives new ideas and directions to follow, and consequently a new conception of the query. Even though participants were asked to conduct the search tasks in their own way, including following interesting links, participants had in general focus on completing the tasks given. A further restriction, in relation to identifying search characteristics supporting the berrypicking model, is that participants were limited to using the online catalogue as the only information source during the simulated search task situations. Use of a wide variety of information sources is an important characteristic of berrypicking (Bates, 1989; 2007).

7.4.2.3 Broad known item/element searches

Categorisation of participants' critical incidents leading to a visit to the Military Museum's online catalogue showed that the majority of participants' leisure related information needs are known item or known element (see section 7.1.3). In general, participants know what they are looking for and due to their long-standing interest in defence and military history they know the professional jargon. The simulated search task situations provided additional information on the applied search strategies. In three out of the four simulated search tasks, the main search strategy applied was a free text search (see Table 7.14). Very few and broad search terms were used, e.g., 'colt' instead of 'colt navy', because ambiguous or insufficient object descriptions challenges the search process:

> *"It is interesting to see what information the Museum holds on the G3 […]. Everyone knows that it is the old German MG42 which was changed and bought by the Danish army in 1962. That is why we call it the M62 machine gun. However, correctly it is called MG3 – Maschine Gewehr drei. But no one knows what a MG3 is. But everyone knows the M62 […]. And what about the production year of the MG3? Is it the production year of the Museum's item or is it the production year of the model?"* (Participant I: line 96).

Likewise due to the sometimes-ambiguous object descriptions, several participants[70] describe how they accept to browse through a long result list to find their known item. That is, low precision is accepted in order to achieve high recall. This finding support a explorative search behaviour and at the same time it confirms how the Military Museum's online collections are viewed as a unique source.

7.4.2.4 Meaning making

Objects displayed in a (virtual) museum do not themselves represent facts nor have any fixed or inherent meaning. Therefore (virtual) museum visitors' interaction with and understanding of a museum object relies on the individual. *Meaning making* or the process by which those objects acquire meaning for individual members of the public will in each case involve the specific memories, expertise, viewpoint, assumptions and connections that the particular brings" (Weil, 2002, p. 212).

Different aspects of meaning making were identified. Firstly, the digitization strategy of the Military Museum's online catalogue, representing a mix of raw and refined information (see Figure 3.2), means, that virtual museum visitors are not directed by the choices and views expressed in carefully designed exhibitions with highly mediated information. Instead they are free to (or forced to) navigate and follow their own paths. In doing so they rely on their background knowledge of defence and military history in order to, e.g., conclude how objects relate or differentiate or in order to make implicit features of information explicit.

To exemplify, participant L looks for characteristics that can help differentiate between similar models and form a general view of the objects in the search result:

> *"When I browsed around looking at the different rifle models 1889s, I tried to establish my own leitmotif. How do they differ? How can I be completely sure? How can I tell the differences between them? Yes, here are two important differences and they will help me differentiate later"*. Participant L: line 98.

Likewise, participant K uses his background knowledge on the Second World War to add to the scarce associated historical context information in the museum catalogue. He tries to establish a link between a specific object and the historical context:

> *"I recognise many of the weapons from what I have read and been told about the Allies' weapon supplies [to Denmark]. However, I'm puzzled about the Russian*

[70] Participant E: line 51, participant Q: line 60, and participant R: line 174.

machine gun in this context. How did that come all the way to Kolding? Maybe, it could be that…" Participant K: line 197.

Also, participants reuse of information and photographs from the online catalogue in other contexts, e.g., in their private archive or on private web sites are an example of meaning making. Finally, a parallel in relation to meaning making can be drawn to the closely related field of family history and genealogy. Yakel (2004) illustrates how broader information needs like seeking meaning and connections are a primary motivation for information seeking activities of genealogists. Accordingly, searching often lacks a clear end goal. A parallel can also be made to Ross's (1999) study of pleasure reading. From an ELIS perspective she found that readers constantly use their previous experience with books and readings to help them interpret new cues.

7.4.3 Summary and discussion concerning searching behaviour

In order to characterise searching behaviour of virtual museum visitors both quantitative and qualitative data from the simulated search task situations was analysed. The results of the quantitative data on search attribute and search strategy dimensions show that especially task C differs from the other three tasks. Task C is the only search task representing an ill-defined, topical information need. The other three tasks represent various types of well-defined information needs. In task C the main search strategy applied was browsing of historical eras combined with semi-directed browsing of result lists. In the other three tasks the main search strategy was free text searching and direct browsing of search results. Moreover, the results indicate an association between task and 'average search time': more time is spent on semantically open topical search tasks.

Based on observations of participants' searching behaviour during the simulated search task situations coupled with an analysis of participants' explanations and comments related to the search sessions, the following four main characteristics of virtual museum visitors' searching behaviour were identified: 1) highly visual experience, 2) exploratory behaviour, 3) broad know item/element search, and 4) meaning making. The four main characteristics are illustrated in Figure 7.2. The first aspect stresses the strong visual aspect of searching virtual museum collections and that photographs are used as scanning, identification, selection, and zooming device. Both the second and and third aspect relate to a hypothesis in the present work. Supported by studies of visitor behaviour in the physical museum, it is a main hypothesis in the present work that virtual museum visitors' information seeking behaviour is highly exploratory covering ill-defined information needs which are not necessarily goal directed. However, results presented in this chapter, from both the web questionnaire and the user study, indicate that information needs of virtual museum visitors are surprisingly well-defined. The main group is know item information needs (see Table 7.7). In general, the simulated search tasks showed how participants used broad search terms and accepted low precision in order to secure high recall. This said, exploratory aspects of searching behaviour were identified across search tasks, for example, information encountering and serendipitous discoveries. Accordingly, the design of information systems providing access to museum collections should support both known item and exploratory searches.

Finally, across tasks *meaning making* is defined as the fourth main aspect virtual museum visitors searching behaviour. In the process of meaning making users rely on their specific background knowledge and experiences to navigate and make sense of information found.

As user study participants in the present study can be characterised as *special interest museum visitors* with some or extensive background information on their hobby interest areas, the four main characteristics of searching behaviour may not represent virtual museum visitors in general. Rather, they may primarily characterise this group of special interest museum visitors.

8 Conclusion, contribution and recommendations for future work

The preceding chapters of the thesis have each contributed to the exploration and characterisation of information seeking behaviour in a digital museum context. The purpose of this final chapter is threefold. First, section 8.1 summarises the thesis objectives, presents the main results of the case study and concludes on the seven research questions. Secondly, section 8.2 outlines the contributions of the thesis, and the final section 8.3 suggests recommendations for future research based on the results of the present study.

8.1 Summary of thesis objectives and results

The overall aim of the thesis is to contribute to improved electronic access to cultural heritage collections by extending our knowledge of information seeking behaviour of both museum curators and virtual museum visitors. Accordingly, the main objective of the present thesis is to investigate and explore information seeking behaviour in a digital museum context.

During the past few years more and more museum collections have been made widely available by digitising cultural heritage collections for the Internet. Opening up databases, however, makes the museum collections available but not necessarily accessible and several studies report on a mismatch between museum documentation and end-users information needs (e.g., Booth, 1998; Chaudhry & Jiun, 2005; Stephenson, 1999; Trant, 2006). At the same time information seeking studies within the museum domain are few and scattered. Motivated by this gap in information seeking studies and the call for a supplementary end-user approach to virtual museum collections, the thesis suggests to draw on knowledge, methods and results from information seeking behaviour research to add to our understanding of why and how both museum curators and virtual museum visitors seek and use resource descriptions of museum objects. While task based information seeking is the core interest of the thesis, the theoretical part of the thesis reflects how it is situated in a rather unique and multidisciplinary intersection of three research areas: information seeking, interactive IR, and museum informatics.

First, chapter 2 presents the integrative cognitive view as outlined by Ingwersen and Järvelin (2005) as the main theoretical foundation of the thesis and positions the thesis within the framework. In the integrative framework information seeking is increasingly seen as contextual to interactive IR. The present work pursues the connection between knowledge learned about information seeking and implications for IR and the influence from the integrated framework can in particular be traced in the following two characteristics of the thesis: 1) involvement of genuine users with individual and real information needs; 2) extension of information seeking towards task context, and 3) integration of information seeking and interactive IR. The present study has applied the integrative framework's research design cube (Ingwersen & Järvelin, 2005, pp. 356-357) and the focus is on three dimensions: the *cognitive actor*, the socio-organisational or cultural *context*, and the *information objects*. This combination of dimensions is *not* described in Ingwersen and Järvelin (2005). Hence, the present case study illustrates and serves as a *novel* fifth case of application of the integrative framework (see also section 8.2 regarding the contributions of the present thesis).

Chapter 3 approaches the virtual museum context and the emerging, multidisciplinary research area of museum informatics defined as the study of how information science and technology affect the museum domain (Marty et al., 2003, p. 259). From a knowledge organisation perspective and based on the theoretical work of Hooper-Greenhill (1992), the chapter argues that resource descriptions in the museum domain reflect the changing roles of museums. Accordingly, a historical perspective is included in the analysis of results in chapter 6. Further, the second part of the chapter discusses perspectives on museum informatics and shows how new technology is becoming an integrated part of the reinvented museum. In direct continuation, the chapter extends Dahlström and Hansson's (2008) distinction between mass and critical digitization by adding a second dimension. Finally, a review of relevant studies of the elusive virtual museum visitors indicates that elements of information seeking have received only little attention so far. This observation together with a call for a supplementing user oriented perspective on museum collections (Booth, 1998; Chaudhry & Jiun, 2005; Stephenson, 1999; Trant, 2006) support the need and overall aim of the present work.

The integrative framework stresses that underlying any purposeful information seeking behaviour is an inclination for solving a work task and the framework views the work task as the central contextual element. Chapter 4 begins by giving an outline of task-based research on IS&R forming the theoretical background for and guiding the research design. The present study, as suggested in the integrative framework, applies a broad definition of work tasks also to include leisure tasks. Thus, virtual museum visitors' information seeking behaviour is examined from a work task perspective in order to connect the task and derived information need with the search process and analyse how they interact. Savolainen's (1995) ELIS framework is introduced and seen as complementary to the integrative framework adding further layers and identifying contextual factors, e.g. personal values and social aspects of information needs, relevant to consider for gaining an understanding and characteristic of the (small part) of everyday practices analysed in the case study. Chapter 4 reviews information seeking studies related to both main user groups. Information seeking studies in leisure contexts indicate that information behaviour during leisure differ from scholar and professional contexts. Only very few information seeking studies exist specifically on museum professionals (a notable exception being Amin et al., 2007). However, the present study shows that several parallels can be drawn between museum professionals and scholarly historians' information seeking, for instance, in relation to the importance of primary sources and the notion of prior familiarity with information sources.

Chapters 2, 3 and 4 constitutes the theoretical part of the thesis and provides a framework and background information for the empirical part in chapters 5, 6 and 7. The empirical part outlines the methodical approach and design of the case study and presents and discusses the results of the case study in relation to the two main user groups.

The present study was conducted as an exploratory case study based primarily on a qualitative research design. The methodical approach, presented in chapter 5, does not claim representativeness. Instead the case study approach is an appropriate method for investigating real-life phenomena with a large variety of factors and relationships. Based on Fidel (1984), the aim was to arrive at a comprehensive understanding of information seeking behaviour of virtual museum visitors and museum curators but at the same time to develop more general statements about the observed phenomena. The research design was directed by two primary concerns: 1) involvement of real users and information systems in real-life situations; and 2) relating findings of information seeking behaviour to system design and representation of museum artefacts. Both aspects relate to the integrated cognitive framework for IS&R.

In relation to the museum professionals a pre-study of informal knowledge gathering was followed by semi-structured in-depth interviews based on the critical incident technique (Flanagan, 1954) with all ten museum curators at the case museum. The interview guide was inspired by Byström and Järvelin's (1995; Byström, 2002) study of work task complexity. Focus was on *object-related* information seeking behaviour, as it is the *dual interaction* between museum objects including their documentation and other information sources that distinguishes museum expert's information seeking behaviour from related experts within the humanities.

The overall research question in relation to the museum professionals states: what characterises information seeking behaviour of museum curators? The first research question (1.a) concerns the characteristics of museum curators' object-related work tasks and derived information needs. Analysis of the interviews identified the following four main object-related work tasks: collection management, exhibition planning and design, research, and answering of inquiries to the museum. The identified types of work tasks correspond largely to the main tasks of cultural heritage experts identified in a study by Amin et al. (2007). Based on curators' perceived work task complexity (Byström & Järvelin, 1995), work tasks of *collection management* and *answering of enquiries* to the museum are mainly characterised by high a priori determinability. Whereas work tasks concerning *exhibition planning and design* and *research* are characterised by low to medium a priori determinability. In work tasks of high a priori determinability information needs are categorised as known item or data element (Ingwersen & Järvelin, 2005, p. 292-293). Whereas information needs derived from work tasks of low a priori determinability cover a wider variety of needs including muddled item and exploratory topical needs.

Across the 15 critical incident descriptions, two primary types of object-related information needs were identified among curators:

1. *Object of prior familiarity:* a need to verify and pursue an all-ready known museum object (or elements of this object)
2. *Overview and exploration*: a need to explore and gain overview of objects related to a certain topic, collection, or time period.

A parallel to the first primary type of information need have been identified among humanities scholars (Bates, 1996b). The second primary type of information need relates both to curators' dependence on serendipitous discoveries and to the difficulties in representing attributes of 'the good museum object' in the indexing process. The difficulties adhere to the non-textuality of museum objects and the many frames of reference an object can represent.

Findings related to the second research question (1.b) on the relationships between types of work tasks and types of information needed in those tasks show that a combination of 'factual, object related information' and the 'museum object' is needed in work tasks representing a high degree of a priori determinability. In contrast, a larger variety of information types are needed in work tasks of medium/low a priori determinability, including 'provenience information' and 'associated, historical context information'. The findings support Byström and Järvelin's conclusion that as task complexity increases, the complexity of information needed also increases as do the variety of information needed (1995, p. 208).

In addition, influenced by a historic dimension (Hooper-Greenhill, 1992) the thesis demonstrates a change in focus from *factual and object related information* to a focus on *provenience information* and *associated, historical context information* as the contextualisation of museum objects has become important.

The third and last research question concerning the museum curator (1.c) relates to their use of information sources. The results show that object-related work tasks of low complexity have very high source internality and the sources most often used were a combination of 'museum object' and 'object documentation'. In contrast, work tasks of medium/high complexity have considerably lower source internality and a wider variety of sources were needed. Again, the results support earlier findings of work task complexity (Byström & Järvelin, 1995; Byström, 2002).

The analysis further shows a preference for written information sources over personal sources and stresses the importance of original sources. The latter correlates with studies of academic historians (Case, 1991; Tibbo, 2002).

In relation to the virtual museum visitors a triangulation of research methods were applied. A web questionnaire survey gave initial, quantitative information about virtual museum visitors and was also used to recruit participants to a succeeding user study.

The first part of the user study investigated virtual museum visitors' searching behaviour by applying simulated search task situations (Borlund, 2000b) and retrospective talk-aloud sessions. The second part of the user study investigated real leisure tasks in a military history context by applying qualitative interviews.

The overall research question in relation to the museum professionals states: what characterises information seeking behaviour of virtual museum visitors? The first research question (2.a) addresses virtual museum visitors' information related leisure tasks and derived information needs.

Based on the serious leisure perspective (Stebbins, 1994), user study participants were categorised as either *collectors* (the largest group) or *liberal art enthusiasts*. Although overlapping, the two hobby types have distinct profiles including the nature of knowledge acquisition. Both data from the web questionnaire and the qualitative interviews showed that objects are *collectors'* primary interest, while the historical context is secondary. *Liberal arts enthusiasts,* on the other hand, define their hobby as a broader historical interest, while the objects are secondary.

Given the hypothesis on virtual museum visitors' exploratory information seeking behaviour, a high percentage of ill-defined information needs reflecting exploratory and semantically open search tasks was expected. However, the identified information needs were surprisingly well-defined known item needs and only few exploratory item or topical information needs were identified. This said, the analysis also indicated results supporting an exploratory seeking behaviour. For example, 30% of the web questionnaire respondents were not looking for anything specific. Further, seven highly exploratory information needs were identified in the critical incidents, which cannot be confined to either hobby type or a more precise information need type. This is an interesting finding supporting that exploratory seeking behaviour exists among users. Unfortunately, data on the seven exploratory information needs was scarce.

Across the two hobby types, user study participants can be characterised as *special interest museum visitors pursuing a long-standing interest or hobby*. Participants' dedication, long-standing interests, and the often considerable time spent on the hobby indicate that their hobbies are integrated components of everyday practices.

The objective of the second research question (2.b), concerning preferred data elements, is to provide suggestions as to which data elements in a searchable museum record are used in which leisure tasks and thereby assist planning of digitization efforts. First and foremost the findings stress the strong visual aspect of searching virtual museum collections. Further, the results show how *collectors* mainly need factual, object-related information, photographs, and provenience information in their leisure tasks. Whereas *liberal arts enthusiasts* need various types of information including associated historic context information and references to further information. The findings confirm Stebbins's (1994, p. 175) proposal that *collectors* seek specific and technical knowledge. In relation to *liberal arts enthusiasts* on the other hand, the questionnaire data did not significantly reflect that they seek broad and humanising knowledge.

The third research question (2.c) relates to what information channels and sources are used in what kinds of leisure tasks. No patterns were identified between use of information sources and leisure tasks. This suggests that the listed information sources are used across different types of leisure tasks of both collectors and liberal arts enthusiasts. In addition, three highly interesting aspects concerning use of sources were found: 1) participants stressed the importance of *personal channels* and the social context of the hobby. Similar reliance on social networks have been identified among family historians (Duff & Johnson, 2003; Yakel, 2004); 2) participants are willing to put a considerable effort into locating, searching, and extracting information; and 3) participants view the Military Museum's online collections as an unique and authoritative source of information mainly because of its authentic objects.

The objective of the fourth and final research question (2.d) was to characterise virtual museum visitors' searching behaviour with focus on how different task types affect search attributes and search strategies. A model (see Figure 7.2) of four main characteristics of virtual museum visitors' searching behaviour is proposed based on observations of participants' searching behaviour during the simulated search task situations in combination with the interviews. The four characteristics identified are: 1) highly visual experience, 2) exploratory behaviour, 3) broad known item/element search, and 4) meaning making. The model illustrates 1) the strong visual aspect of searching virtual museum collections, and 2) that a combination of (surprisingly) well-defined and exploratory information needs exists, and accordingly that the design of information systems providing access to museum collections should support both known item and exploratory searches.

Taking a comparative view the case study shows important distinctions between hobbyists and museum curators. In relation to sources, for example, hobbyists rely heavily on personal sources and Internet sources. Whereas the museum professionals rely primarily on object documentation and literature and only little on personal sources. In relation to type of information needed similarities are found between the museum curators and *liberal arts enthusiast*. Both groups need a broad variety of information types. The largest group of hobbyist participants, *the collectors*, on the other hand place primary emphasis on factual, object related information. This suggests that the museum's aim at moving towards a *critical digitization* strategy including more mediated information (towards Ex3 and Ex4 in Figure 3.2) especially will apply to liberal arts enthusiasts.

Finally, as discussed in section 3.1.3, several earlier studies (Chaudhry & Jiun, 2005; Orna & Pettit, 1998; Stephenson, 1999, Trant 2006) report on a mismatch between museum documentation and user needs. Results from the present study concerning preferred data elements do not support the findings from the aforementioned studies. In general, participants reported on no problems related to, e.g., understanding the specialist terminology used in the online catalogue. The user study participants' high level of experience and long-standing hobby interests are probably the main explanations of why no mismatch is identified in present study.

8.2 Contributions

The main contributions derived from the theoretical and empirical work of the thesis are the following:

Extending Ingwersen and Järvelin's (2005) *integrative cognitive framework by a novel fifth case-based perspective*

Ingwersen and Järvelin introduce a multidimensional research design cube in order to help construct powerful future research designs of IS&R studies from an integrative point of view. The present thesis contributes with empirical research within the integrated cognitive framework (Ingwersen & Järvelin, 2005). The case study focus on variables along the following three dimensions: the *cognitive actor*, the socio-organisational or cultural *context*, and the *information object* (see Table 2.1 p. 34). This combination of dimensions is *not* described in Ingwersen and Järvelin (2005). Hence, the present case study illustrates and serves as a *novel* fifth case-based application of the integrative framework. Thereby the present work contributes to accumulate the understanding of task-based IS&R and it follows the call by Ingwersen and Järvelin (2005, p. 3) to consider theoretical understanding, empirical explanation and supporting technological development in the area of interest – a digital museum context.

Verification of earlier studies (Byström & Järvelin, 1995; Byström, 2002) of work task complexity

The thesis explores museum curators' object-related information seeking from a work-task perspective. The results verify Byström and Järvelin's studies (1995; Byström, 2002) on the relationships between task complexity and information seeking and use: as task complexity increases,

- the complexity and variety of information needed increase (the needs for provenience information and associated, historical context information increases),
- the number of types of information sources increases, and
- the internality of sources decreases.

Contribution to the emerging field of museum informatics

The emerging field of museum informatics can broadly be described as the study of how information science and technology affect the museum domain (Marty et al., 2003, p. 259). The empirical results and theoretical analysis in this thesis contribute to the field of museum informatics by adding to the characteristic of the elusive virtual museum visitor, e.g., by providing knowledge about visitor motivation, the leisure context of the visit, and the identification of the following four main characteristics of searching behaviour: highly visual experience, exploratory behaviour, broad know item/element search, and meaning making. The results can contribute to creating access to digital museum collections, for instance as input to design adaptive interfaces based on different user requirements (Paterno & Mancini, 2000). Also the opportunity of personalisation (my museum) depends on knowledge of among other things the information seeking behaviour of museum visitors (Hooper-Greenhill, 1992, p. 215). Hopefully the present work will contribute to mutual understanding between the disciplines of museum studies and information science.

Extension of Dahlström and Hansson's (2008) *distinction between critical versus mass digitization*
Based on practice and examples within libraries, Dahlström and Hansson (2008) propose a useful distinction between mass and critical digitization to support analyses of digitization practices within cultural heritage. The present work applies their distinction to the museum domain and suggests adding a second dimension concerning *the degree of virtual uniqueness* (see Figure 3.2).

Exploratory searching and the employment of simulated search task situations
Simulated search task situations (Borlund, 2000b) were applied as one of the research tools to collect data on virtual museum visitors' searching behaviour. The data collection method contributed to investigate how different task types affect search attributes and search strategies. However, the analysis indicates that some aspects of *exploratory* searching behaviour are difficult to capture by using simulated search task situations. For instance, several participants transformed the semantically open and ill-defined search task to a known item task. Likewise, the very assignment of a task contradicts undirected browsing (Marchionini, 1995) which is an expected part of exploratory searching. Thus, through the use of different types of simulated search tasks, both well-defined and exploratory, the thesis contributes with methodical reflections concerning simulated search task situations as a data collection method.

8.3 Recommendations for future work

In continuation of the results and contributions of the present study, this section suggests recommendations for future research.

Based on the results concerning museum professionals it would be interesting to investigate also the part of information seeking concerning museum professionals' *searching behaviour*. For instance, to investigate museum curators' needs in relation to gaining overview and facilitating serendipitous discoveries. The present case museum represents a museum in the process of adapting more and more information technology and successively digitizing primary sources and documentation. At present only limited access points exists. Thus, the recommended study would require a more advanced information technology system.

The present results regarding virtual museum visitors add to a characteristic of the elusive new type of museum visitor. At the same time, however, many questions remain unanswered due to the nature of a case study and the many technological developments related to digitization of museum collections. Based on the results concerning virtual museum visitors the following recommendations are suggested for future research:

Firstly, the present case study focuses on a small museum collection including objects from one museum only. The results show that participants use a variety of different Internet sources. Accordingly, a more realistic research design might encompass *investigation of larger collections with objects from many museums*. E.g., the new Europeana portal[71] aims at providing access to 6 million digital objects from various European cultural heritage institutions in 2010.

Secondly, participants in the present study were characterised as special interest museum visitors (with medium or extensive background knowledge) pursuing a long-standing interest or hobby. Data from the web questionnaire show that the Military Museum’s online catalogue was also used by novice users. Drawing on distinctions between different digitization strategies (mass versus critical – see Dahlström and Hansson, 2008), it would be interesting to *improve our knowledge on the group of novice users*. In continuation also other user groups could be investigated, e.g., from a combined seeking and (life-long) learning perspective.

Thirdly, it was a main hypothesis that virtual museum visitors seek information in a highly exploratory and non-goal oriented manner. However, results show their information needs to be surprisingly well-defined even though also traits of exploratory behaviour were identified. Based on the methodical reflections of the present work, future research should be designed to better *capture exploratory seeking behaviour of virtual museum visitors.*

In conclusion, as stated in chapter 3, the title of the thesis signals that the present case study has been conducted within the context of a changing museum domain, where museums 1) have become repositories of knowledge (Hooper-Greenhill, 1992) and

[71] Link to the Europeana Portal: http://www.europeana.eu/portal/

visitor-centred (G. Anderson, 2004), and 2) have become influenced by information technology resulting in the emerging field of museum informatics. Museum visitors play an increasingly important role in the reinvented museum. If the aim is to make digitalized museum collections not only *available* on the Internet but also *accessible*, further knowledge is needed on virtual museum visitors' information seeking behaviour. This thesis contributes to extending our knowledge on information seeking and its implication for resource description.

9 References

Agosto, D. E., & Hughes-Hassell, S. (2005). People, places, and questions: An investigation of the everyday life information-seeking behaviors of urban young adults. *Library and Information Science Research, 27*(2), 141-163.

Allen, B. L. (1997). Information needs: A person-in-situation approach. In P. Vakkari, R. Savolainen & B. Dervin (Eds.), *Information seeking in context* (pp. 111-122). London: Taylor Graham.

Amin, A. K., Hardman, L., & Ossenbruggen, J. R. v. (2007). *Searching in the cultural heritage domain: Capturing cultural heritage expert information seeking need.* (Report no. INS-R0701). Amsterdam: Centrum voor Wiskunde en Informatica.

Anderson, G. (2004). *Reinventing the museum: Historical and contemporary perspectives on the paradigm shift.* Lanham: Altamira Pr.

Anderson, J. D. (1997). Organization of knowledge. In J. Feather, & P. Sturges (Eds.), *International encyclopedia of information and library science* (pp. 336-353). London: Routledge.

Arampatzis, A., Kamps, J., Koolen, M., & Nussbaum, N. (2007). MuSeUM: Unified access to the state of the art. *Proceedings of the Seventh Dutch-Belgian Workshop on Information Retrieval (DIR 2007),*

Barrett, A. (2005). The information-seeking habits of graduate student researchers in the humanities. *The Journal of Academic Librarianship, 31*(4), 324-331.

Bates, M. J. (1986). An exploratory paradigm for online information retrieval. In B. C. Brookes (Ed.), *Intelligent information systems for the information society: Proceedings of the Sixth International Research Forum in Information Science (IRFIS 6), Franscati, Italy, September 16-18, 1985* (pp. 91-99).

Bates, M. J. (1989). The design of browsing and berrypicking techniques for the online search interface. *Online Review, 13*(5), 407-424.

Bates, M. J. (1994). The design of databases and other information resources for humanities scholars: The Getty online searching project report no. 4. *Online & CDROM Review, 18*(6), 331-340.

Bates, M. J. (1996a). Document familiarity, relevance, and bradford's law: The Getty online searching project report no. 5. *Information Processing and Management, 32*(6), 697-707.

Bates, M. J. (1996b). The Getty end-user online searching project in the humanities: Report no. 6: Overview and conclusions. *College & Research Libraries, 57*(6), 514-523.

Bates, M. J. (1996c). Learning about the information seeking of interdisciplinary scholars and students. *Library Trends, 45*(2), 155-164.

Bates, M. J. (2007). What is browsing - really? A model drawing from behavioural science research. *Information Research, 12*(4).

Baudrillard, J. (1996). *The system of objects*. London: Verso.

Bearman, D., & Trant, J. (2000). When museum informatics meets the world wide web. *Journal of the American Society for Information Science, 51*, 3-4.

Bearman, D., & Trant, J. (2005). Social terminology enhancement through vernacular engagement: Exploring collaborative annotation to encourage interaction with museum collections. *D-Lib Magazine, 11*(9)

Beattie, D. L. (1989). An archival user study: Researchers in the field of women's history. *Archivaria, 29*(Winter 1989-90), 33-50.

Belkin, N. J. (1977). Internal knowledge and external information. *International Workshop on the Cognitive Viewpoint* (pp. 187-194), Ghent: University of Ghent.

Belkin, N. J. (1980). Anomalous states of knowledge as a basis for information retrieval. *The Canadian Journal of Information Science, 5*, 133-143.

Belkin, N. J. (1984). Cognitive models and information transfer. *Social Science Information Studies, 4*, 111-129.

Belkin, N. J. (1990). The cognitive viewpoint in information science. *Journal of Information Science, 16*, 11-15.

Belkin, N. J. (1993). Interaction with texts: Information retrieval as information seeking behaviour. *Information Retrieval '93* (pp. 55-66). Konstanz: Universitetsverlag Konstanz.

Belkin, N. J., Oddy, R. N., & Brooks, H. M. (1982). ASK for information retrieval: Part I. background and theory. *Journal of Documentation, 38*(2), 61-71.

Belkin, N. J., & Robertson, S. E. (1976). Information science and the phenomenon of information. *Journal of the American Society for Information Science, 27*, 197-204.

Belkin, N. J., Seeger, T., & Wersig, G. (1982). Distributed expert problem treatment as a model for information system analysis and design. *Journal of Information Science, 5*(5), 153-167.

Bellavista, P., Corradi, A., & Tomasi, A. (2000). The mobile agent technology to support and to access museum information. 1006-1013.

Benjamin, W. (1970). *The work of art in the age of mechanical reproduction*. London: Jonathon Cape.

Björneborn, L. (2008). Serendipity dimensions and users' information behaviour in the physical library interface. *Information Research, 13*(1).

Black, G. (2005). *The engaging museum: Developing museums for visitor involvement*. London: Routledge.

Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Reviews in Psychology, 54*, 579-616.

Booth, B. (1998). Understanding the information needs of visitors to museums. *Museum Management and Curatorship, 17*(2), 139-157.

Borlund, P. (2000a). *Evaluation of interactive information retrieval systems*. Åbo: Akademi University Press.

Borlund, P. (2000b). Experimental components for the evaluation of interactive information retrieval systems. *Journal of Documentation, 56*(1), 71-90.

Borlund, P. (2003). The concept of relevance in IR. *Journal of the American Society for Information Science and Technology, 54*(10), 913-925.

Borlund, P., & Ingwersen, P. (1997). The development of a method for the evaluation of interactive information retrieval systems. *Journal of Documentation*, *53*(3), 225-250.

Borysewicz, S. (1998). Networked media: The experience is closer than you think. In S. Thomas, & A. Mintz (Eds.), *The virtual and the real: Media in the museum* (pp. 103-116). Washington: American Associations of Museums.

Boyce, B. R., Meadow, C. T., & Kraft, D. H. (1994). *Measurement in information science*. San Diego, CA: Academic Press.

Brookes, B. C. (1975). The fundamental problem of information science. In V. Horsnell (Ed.), *Informatics 2* (pp. 42-49). London: Aslib.

Brookes, B. C. (1977). The developing cognitive viewpoint in information science. In M. de Mey, R. Pinxten, M. Poriau & F. Vandamme (Eds.), *International Workshop on the Cognitive Viewpoint* (pp. 195-203). Ghent: University of Ghent.

Buck, R. A., & Gilmore, J. A. (1998). *The new museum registration methods*. Washington, DC: American Association of Museums.

Buckingham, A., & Saunders, P. (2004). *The survey methods workbook: From design to analysis*. Cambridge, UK: Polity.

Burcaw, G. E. (1997). *Introduction to museum work*. Walnut Creek, CA: Altamira Press.

Butterworth, R., & Perkins, V. D. (2006). Using the information seeking and retrieval framework to analyse non-professional information use. In I. Ruthven, P. Borlund, P. Ingwersen, N. J. Belkin, A. Tombros & P. Vakkari (Eds.), *Information Interaction in Context: International Symposium on Information Interaction in Context (IIiX 2006), Copenhagen, Denmark, 18-20 October, 2006* (pp. 275-287). New York, NY: ACM Press.

Byström, K. (2002). Information and information sources in tasks of varying complexity. *Journal of the American Society for Information Science and Technology, 53*(7), 581-591.

Bystrom, K., & Hansen, P. (2005). Conceptual framework for tasks in information studies. *Journal of the American Society for Information Science and Technology, 56*, 1050-1061.

Byström, K., & Järvelin, K. (1995). Task complexity affects information seeking and use. *Information Processing & Management*, *31*(2), 191-213.

Cameron, F., & Kenderdine, S. (2007). *Theorizing digital cultural heritage: A critical discourse*. Cambridge, Mass.: MIT Press.

Cameron, F., & Robinson, H. (2007). Digital knowledgescapes: Cultural, theoretical, practical, and usage issues facing museum collection databases in a digital epoch. In F. Cameron, & S. Kenderdine (Eds.), *Theorizing digital cultural heritage: A critical discourse* (pp. 165-192). Cambridge, MA: MIT Press.

Case, D. O. (1991). The collection and use of information by some american historians: A study of motives and methods. *Library Quarterly, 61*(1), 61-82.

Case, D. O. (2002). *Looking for information: A survey of research on information seeking, needs, and behavior*. Amsterdam: Academic Press.

Chadwick, J., & Boverie, P. (1999). A survey of characteristics and patterns of behavior in visitors to a museum web site. In D. Bearman, & J. Trant (Eds.), *Museums and the Web 1999: Proceedings*. Pittsburgh, PA: Archives and Museum Informatics.

Chan, S. (2007). Tagging and searching: Serendipity and museum collection databases. In D. Bearman, & J. Trant (Eds.), *Museums and the Web 2007: Proceedings.* San Francisco, CA: Archives and Museum Informatics.

Chang, S. J., & Rice, R. E. (1993). Browsing: A multidimensional framework. In M.E. Williams (Ed.), *Annual Review of Information Science and Technology (ARIST)* (pp. 231-276). Medford, NJ: Learned Information.

Chaudhry, A. S., & Jiun, T. P. (2005). Enhancing access to digital information resources on heritage: A case of development of a taxonomy at the integrated museum and archives system in singapore. *Journal of Documentation, 61*(6), 751-776.

Christensen, J. O. (2006). Sikring af forsvarshistorisk kulturarv i Danmark. *Nordisk Museologi, 2,* 45-62.

Chu, C. M. (1999). Literary critics at work and their information needs: A research-phases model. *Library and Information Science Research, 21*(2), 247-273.

Cleverdon, C. W., & Keen, E. M. (1966). Aslib Cranfield research project: Factors determining the performance of indexing systems (vol. 2: Results).

Cleverdon, C. W., Mills, J., & Keen, E. M. (1966). Aslib Cranfield research project: Factors determining the performance of indexing systems (vol 1: Design).

Cole, C. (1998). Information acquisition in history Ph.D. students: Inferencing and the formation of knowledge structures. *Library Quarterly, 68*(1), 33-54.

Cole, C., & Leide, J. E. (2006). A cognitive framework for human information behavior: The place of metaphor in human information organizing behavior. In A. Spink, & C. Cole (Eds.), *New directions in human information behaviour* (pp. 171-202). Dordrecht: Springer.

Cool, C., & Spink, A. (2002). Issues of context in information retrieval (IR): An introduction to the special issue. *Information Processing & Management, 38*, 605-611.

Cosijn, E. (2006). Relevance judgements within teh context of work tasks. In I. Ruthven, p. Borlund, P. Ingwersen, N. J. Belkin, A. Tombros & P. Vakkari (Eds.), *Information Interaction in Context: International Symposium on Information Interaction in Context (IIiX 2006), Copenhagen, Denmark, 18-20 October, 2006* (pp. 33-49). New York, NY: ACM Press.

Cunliffe, D., Kritou, E., & Tudhope, D. (2001). Usability evaluation for museum web sites. *Museum Management and Curatorship, 19*(3), 229–252.

Dahlström, M., & Hansson, J. (2008). On the relation between qualitative digitization and library institutional identity. In C. Arsenaults, & J. T. Tennis (Eds.), *Culture and Identity in Knowledge Organization: Proceedings of the Tenth International ISKO Conference, 5-8 August, Montréal, Canada* (pp. 111-117). Würzburg: Ergon.

De Mey, M. (1977). The cognitive veiwpoint: Its development and its scope. In M. De Mey, R. Pinxten, M. Poriau & F. Vandamme (Eds.), *International Workshop on the Cognitive Viewpoint* (pp. xvi-xxxii). Ghent: University of Ghent.

De Mey, M. (1980). The relevance of the cognitive paradigm for information science. In O. Harbo & L. Kajberg (eds.), *Theory and Application of Information Research. Proceedings of the 2nd International Research Forum on Information Science, 3-6 August 1977, Royal School of Librarianship, Copenhagen, (pp. 48-61)* London, UK: Mansell.

De Mey, M. (1982). *The cognitive paradigm: Cognitive science, a newly explored approah to the study of cognition applied in an analysis of science and scientific knowledge*. Dordrecht, Holland: Reidel.

De Mey, M. (1984). Cognitive science and science dynamics: Philosophical and epistemological issues for information science. *Social Science Information Studies, 4*(2-3), 97-110.

Dervin, B. (1983). An overview of sense-making research: Concepts, methods and results to date. *International Communications Association Annual Meeting*, Dallas, TX, 1983.

Dervin, B. (1992). From the mind's eye of the user: The sense-making qualitative-quantitative methodology. In J. D. Glazier, & R. R. Powell (Eds.), *Qualitative research in information management* (pp. 61-84). Englewood, Colo.: Libraries Unlimited.

Dervin, B. (1997). Given a context by any other name: Methodological tools for taming the unruly beast. In P. Vakkari, R. Savolainen & B. Dervin (Eds.), *Information seeking in context: proceedings of an international conference of research in information needs, seeking and use in different contexts. Tampere, Finland, 1997* (pp. 13-38). London: Taylor Graham Publishing.

Dervin, B., Zweizig, D., Banister, M., Gariel, M., Hall, E., & Kwan, C. (1976). *The development of strategies for dealing with the information needs of urban residents. phase 1: Citizen study*. Washington, DC: Department of Health, Education and Welfare, Office of Education, Office of Libraries and Learning Resources.

Duff, W. M., & Johnson, C. A. (2002). Accidentally found on purpose: Information-seeking behavior of historians in archives. *Library Quarterly, 72*(4), 472-496.

Duff, W. M., & Johnson, C. A. (2003). Where is the list with all the names? Information-seeking behavior of genealogists: Users and archival research. *The American Archivist, 66*(1), 79-95.

Ellis, D. (1989). A behavioural approach to information retrieval system design. *Journal of Documentation, 45*(3), 171-212.

Ellis, D. (1992). The physical and cognitive paradigms in information retrieval research. *Journal of Documentation, 48*(1), 45-64.

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

Erdelez, S. (1997). Information encountering: A conceptual framework for accidental information discovery. In P. Vakkari, R. Savolainen & B. Dervin (Eds.), *Information seeking in context: Proceedings of an International Conference on Research in Information Needs, Seeking and Use in Different Contexts, 14-16 August, 1996, Tampere, Finland* (pp. 412-421). London, UK: Taylor Graham Publishing.

Erdelez, S. (2000). Towards understanding information encountering on the web. In D. H. Kraft (Ed.), *Proceedings of the 63rd ASIS Annual Meeting, 12-16 November, 2000, Chicago* (pp. 363-371). Medford, NJ: Information Today.

Erdelez, S. (2005). Information encountering. In K. E. Fisher, S. Erdelez & L. E. F. McKechnie (Eds.), *Theories of information behavior* (pp. 179-184). Medford, NJ: Information Today.

European Commission. Directorate-General for the Information Society. (2002). *The DigiCULT report: Technological landscapes for tomorrow's cultural economy: Unlocking the value of cultural heritage*. Luxembourg: Office for Official Publications of the European Communities.

Falk, J. H., & Dierking, L. D. (1992). *The museum experience*. London: Howells House.

Fidel, R. (1984). The case study method: A case study. *Library and Information Science Research, 6*(3), 273-288.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin, 51*(4), 327-358.

Flanagin, A. J., & Metzger, M. J. (2001). Internet use in the contemporary media environment. *Human Communication Research, 27*(1), 153-181.

Foster, A., & Ford, N. (2003). Serendipity and information seeking: An empirical study. *Journal of Documentation, 59*(3), 321-340.

Foster, A. (2005). A non-linear model of information seeking behaviour. *Information Research, 10*(2).

Foucault, M. (1970). The order of things: An archaeology of the human sciences.

Foucault, M. (1974). *The archaeology of knowledge*. London: Tavistock Publications.

Frankfort-Nachmias, C., & Nachmias, D. (2000). *Research methods in the social sciences.* New York, NY: Worth Publishers.

Frohmann, B. (1992). The power of images: A discourse analysis of the cognitive viewpoint. *Journal of Documentation, 48*(4), 365-386.

Galloway, P. (2004). Preservation of digital objects. In B. Cronin (Ed.), *Annual Review of Information Science and Technology* (pp. 549-590). Medford, N.J.: Information Today.

Gibson, H., Morris, A., & Cleeve, M. (2007). Links between libraries and museums: Investigating museum-library collaboration in england and the USA. *Libri, 57*(2), 53-64.

Glazier, J. D. (1992). Qualitative research methodologies for library and information science: An introduction. In J. D. Glazier, & R. R. Powell (Eds.), *Qualitative research in information management* (pp. 1-13). Englewood, CO: Libraries Unlimited.

Goldman, K. H., & Schaller, D. (2004). Exploring motivational factors and visitor satisfaction in on-line museum visits. In D. Bearman, & J. Trant (Eds.), *Museums and the Web 2004: Proceedings* (pp. 223-235). Toronto, Canada: Archives & Museum Informatics.

Graf, B. (1994). Visitor studies in Germany: Methods and examples. In R. Miles, & L. Zavala (Eds.), *Towards the museum of the future: New European perspectives* (pp. 75-80). London: Routledge.

Green, R. (2000). Locating sources in humanities scholarship: The efficacy of following bibliographic references. *The Library Quarterly, 70*(2), 201-229.

Greene, R. (2004). *Internet art*. London: Thames & Hudson.

Griffiths, J. M., & King, D. W. (2007). Physical spaces and virtual visitors: The methodologies of comprehensive study of users and uses of museums. In J. Trant, & D. Bearman (Eds.), *International Cultural Heritage Meeting (ICHIM07): Proceedings*. Toronto: Archives & Museum Informatics.

Haak, M. J. V. d., de Jong, M. D. T., & Schellens, P. J. (2003). Retrospective vs. concurrent think-aloud protocols: Testing the usability of an online library catalogue. *Behaviour & Information Technology, 22*(5), 339-351.

Haak, M. J. V. d., de Jong, M. D. T., & Schellens, P. J. (2004). Employing think-aloud protocols and constructive interaction to test the usability of online library catalogues: A methodological comparison. *Interacting with Computers, 16*(6), 1153-1170.

Haapalainen, R. (1999). Revising the Finnish National Gallery's web page. In D. Bearman, & J. Trant (Eds.), *Museums and the Web 1999: Proceedings*. Pittsburgh, PA: Archives and Museum Informatics.

Hansen, P. (1999). User interface design for IR interaction: A task-oriented approach. In T. Aparac, T. Saracevic, P. Ingwersen & P. Vakkari (Eds.), *Digital libraries: Interdisciplinary concepts, challenges and opportunities: Proceedings of the Third International Conference on the Conceptions of the Library and Information Science, Dubrovnik, Croatia, May 23-26* (pp. 191-205)

Harbo, O., Ingwersen, P., & Timmermann, P. (1977). Cognitive processes in information storage and retrieval. *International Workshop on the Cognitive Viewpoint,* Ghent. 214-218.

Hartel, J. (2003). The serious leisure frontier in library and information science: Hobby domains. *Knowledge Organization, 30*(3-4), 228-238.

Hartel, J. (2005). Serious leisure. In K. E. Fisher, S. Erdelez & L. E. F. McKechnie (Eds.), *Theories of information behaviour* (pp. 313-317). Medford, NJ: Information Today.

Hartel, J. (2006). Information activities and resources in an episode of gourmet cooking. *Information Research, 12*(1).

Hektor, A. (2003). Information activities on the internet in everyday life. *The New Review of Information Behaviour Research, 4*(1), 127-138.

Hertzum, M. (1998). A review of museum web sites: In search of user-centred design. *Archives and Museum Informatics, 12*(2), 127-138.

Hertzum, M. (1999). A review of museum web sites: In search of user-centred design. *Archives and Museum Informatics, 12*(2), 127-138.

Hertzum, M., & Pejtersen, A. M. (2000). The information-seeking practices of engineers: Searching for documents as well as for people. *Information Processing and Management, 36*(5), 761-778.

Hirsh, S. G. (1999). Information seeking at different stages of the R&D research process. In M. Hearst, F. Gey & R. Tong (Eds.), *Proceedings of the 22nd International Conference on Research and Development in Information Retrieval* (pp. 285-286). Berkely, CA: University of California.

Hjerppe, R. (1994). A framework for the description of generalised documents. In H. Albrechtsen & S. Ørnsager (eds.), *Knowledge Organization and Quality Management: Proceedings of the Third International ISKO Conference. Advances in Knowledge Organization,* no. 4 (pp. 173-180). Frankfurt: Indeks Verlag.

Hjørland, B. (1997). *Information seeking and subject representation: An activity-theoretical approach to information science*. Westport, Conneticut: Greenwood Press.

Hjørland, B., & Albrechtsen, H. (1995). Toward a new horizon in information science: Domain-analysis. *Journal of the American Society for Information Science, 46*(6), 400-425.

Hooper-Greenhill, E. (1992). *Museums and the shaping of knowledge*. London: Routledge.

Hyldegård, J. (2009). Beyond the search process - exploring group members' information behavior in context. *Information Processing and Management, 45*, 142-158.

Hyldegård, J., & Ingwersen, P. (2007). Task complexity and information behavior in group based problem solving. *Information Research, 12*(4).

Hyvönen, E., Salminen, M., Kettula, S., & Junnila, M. (2004). A content creation process for the semantic web. *Proceeding of OntoLex 2004: Ontologies and Lexical Resources in Distributed Environments,* Lisbon, Portugal.

Ingwersen, P. (1982). Search procedures in the library analysed form the cognitive point of view. *Journal of Documentation, 38*(3), 165-191.

Ingwersen, P. (1984). Psychological aspects of information retrieval. *Social Science Information Studies, 4*(2/3), 83-95.

Ingwersen, P. (1992). *Information retrieval interaction*. London: Taylor Graham.

Ingwersen, P. (1996). Cognitive perspectives of information retrieval interaction: Elements of a cognitive IR theory. *Journal of Documentation, 52*(1), 3-50.

Ingwersen, P. (1999). Cognitive information retrieval. In M.E. Williams (Ed.), *Annual Review of Information Science and Technology (ARIST), (vol. 34*, pp. 3-52). Medford, NJ: Information Today.

Ingwersen, P. (2001). Users in context. In M. Agosti, F. Crestani & G. Pasi (Eds.), *Lectures on Information Retrieval: Third European Summer-school, ESSIR 2000, Varenna, Italy, September 11-15, 2000* (pp. 157-178). Berlin: Springer.

Ingwersen, P., & Järvelin, K. (2005). *The turn: Integration of information seeking and retrieval in context*. Berlin, Germany: Springer.

Ingwersen, P., & Järvelin, K. (2007). On the holistic cognitive theory for information retrieval: Drifting outside the cave of the laboratory framework. In S. Dominich, & F. Kiss (Eds.), *Studies in theory of information retrieval* (ICTIR 2007) (pp. 135-147). Budapest, Hungary: Foundation for Information Society.

Järvelin, K. (1986). On information, information technology and the development of society: An information science perspective. In P. Ingwersen, L. Kajberg & A. M. Pejtersen (Eds.), (pp. 35-55)

Järvelin, K. (2007). An analysis of two approaches in information retrieval: From frameworks to study designs. *Journal of the American Society for Information Science and Technology, 58*(7), 971-986.

Järvelin, K., & Ingwersen, P. (2004). Information seeking research needs extension towards tasks and technology. *Information Research, 10*(1).

Jessen, H. (2005). Den levende indsamling: Biologisk kultur som museal udfordring. *Årsskrift for Medicinsk Museion*, pp. 9-18.

Johnson, J. D. (2003). On contexts of information seeking. *Information Processing & Management, 39*(5), 735-760.

Johnson, J. D., Andrews, J. E., & Allard, S. (2001). A model for understanding and affecting cancer genetics information seeking. *Library and Information Science Research, 23*(4), 335-349.

Jones-Garmil, K. (1997). *The wired museum: Emerging technology and changing paradigms* Washington, DC: American Association of Museums.

Keene, S. (1998). *Digital collections: Museums and the information age* Butterworth-Heinemann.

Kelly, D. (2006a). Measuring online information seeking context, part 1: Background and method. *Journal of the American Society for Information Science and Technology, 57*(13), 1729-1739.

Kelly, D. (2006b). Measuring online information seeking context, part 2: Findings and discussion. *Journal of the American Society for Information Science and Technology, 57*(14), 1862-1874.

Kelly, D., Dollu, V. D., & Fu, X. (2005). The loquacious user: A document-independent source of terms for query expansion. 457-464.

Kravchyna, V. (2004). *Information needs of art museum visitors: Real and virtual.* Unpublished PhD thesis, University of North Texas.

Kuhlthau, C. C. (1991). Inside the search process: Information seeking from the user's perspective. *Journal of the American Society for Information Science, 42*(5), 361-371.

Kvale, S. (1997). *Interview: En introduktion til det kvalitative forskningsinterview*. København: Hans Reitzel.

Larsen, B. (2004). *References and citations in automatic indexing and retrieval systems: Experiments with the boomerang effect.* Unpublished PhD thesis. Copenhagen: Royal School of Library and Information Science.

Luria, A. R. (1976). *Cognitive development: Its cultural and social foundations*. London, UK: Harvard University Press.

Lykke Nielsen, M. (2002). *The word association method: A gateway to work-task based retrieval*. Åbo, Finland: Åbo Akademi University Press.

Marchionini, G. (1995). *Information seeking in electronic environments*. Cambridge, MA: Cambridge University Press.

Marchionini, G. (2006). Exploratory search: From finding to understanding. *Communications of the ACM, 49*(4), 41-46.

Marty, P. F. (2000). On-line exhibit design: The sociotechnical impact of building a museum over the world wide web. *Journal of the American Society for Information Science and Technology, 51*(1), 24-32.

Marty, P. F. (2007). Museum professionals and the relevance of LIS expertise. *Library and Information Science Research, 29*(2), 252-276.

Marty, P. F., Rayward, W. B., & Twidale, M. B. (2003). Museum informatics. In B. Cronin (Ed.), *Annual Review of Information Science and Technology* (ARIST), (pp. 259-294). Medford, NJ: Information Today.

McKenzie, P. J. (2003). A model of information practices in accounts of everyday-life information seeking. *Journal of Documentation, 59*(1), 19-40.

McManus, P. M. (1996). Visitors: Their expectations and social behaviour. In G. Durbin (Ed.), *Developing museum exhibitions for lifelong learning* (pp. 59-62). London: The Stationery Office.

Mordhorst, C. (2005). Repræsentationens begrænsning. In C. Mordhorst, & B. Tøndborg (Eds.), *(Ind)samlinger i det 21. århundrede* (pp. 9-24). København: Institut for Kunst- og Kulturvidenskab, Københavns Universitet.

Nicholas, D., Huntington, P., & Dobrowolski, T. (2006). The digital information consumer. In A. Spink, & C. Cole (Eds.), *New Directions in Human Information Behavior* (pp. 203-228). Dordrecht: Springer.

Orna, E., & Pettitt, C. W. (1998). *Information management in museums*. Aldershot: Gower.

Park, T. K. (1993). The nature of relevance in information retrieval: An empirical study. *Library Quarterly, 63*(3), 318-351.

Parry, R. (2005). Digital heritage and the rise of theory in museum computing. *Museum Management and Curatorship, 20*(4), 333-348.

Paterno, F., & Mancini, C. (2000). Effective levels of adaptation to different types of users in interactive museum systems. *Journal of the American Society for Information Science, 51*(1), 5-13.

Peacock, D., & Brownbill, J. (2007). Audiences, visitors, users: Reconceptualising users of museum on-line content and services. In D. Bearman, & J. Trant (Eds.), *Museums and the Web 2007: Proceedings*. Toronto: Archives & Museum Informatics.

Pejtersen, A. M. (1989). A library system for information retrieval based on a cognitive task analysis and supported by an icon-based interface. *ACM SIGIR Forum*, pp. 40-47.

Qu, Y., & Furnas, G. W. (2008). Model-driven formative evaluation of exploratory search: A study under a sensemaking framework. *Information Processing and Management, 44*(2), 534-555.

Rinehart, R. (2003). MOAC - a report on integrating museum and archive access in the online archive of California. *D-Lib Magazine, 9*(1).

Robertson, S. E., & Hancock-Beaulieu, M. M. (1992). On the evaluation of IR systems. *Information Processing & Management, 28*(4), 457-466.

Ross, C. S. (1999). Finding without seeking: The information encounter in the context of reading for pleasure. *Information Processing and Management, 35*(6), 783-799.

Ruthven, I., Lalmas, M., & Rijsbergen, K. (2003). Incorporating user search behavior into relevance feedback. *Journal of the American Society for Information Science and Technology, 54*(6), 529-549.

Saracevic, T. (1996). Modeling interaction in information retrieval (IR): A review and proposal. *59th Annual Meeting of the American Society for Information Science,* 3-9.

Saracevic, T. (1997). User lost: Reflections on the past, future, and limits of information science. *ACM SIGIR Forum, 31*(2), 16-27.

Saracevic, T., & Kantor, P. (1988a). A study of information seeking and retrieving. II. users, questions, and effectiveness. *Journal of the American Society for Information Science, 39*(3), 177-196.

Saracevic, T., & Kantor, P. (1988b). A study of information seeking and retrieving. III. searchers, searches, and overlap. *Journal of the American Society for Information Science, 39*(3), 197-216.

Saracevic, T., Kantor, P., Chamis, A. Y., & Trivison, D. (1988). A study of information seeking and retrieving. I. background and methodology. *Journal of the American Society for Information Science, 39*(3), 161-176.

Savolainen, R. (1995). Everyday life information seeking: Approaching information seeking in the context of "way of life". *Library & Information Science Research*, *17*, 259-294.

Schamber, L. (2000). Time-line interviews and inductive content analysis: Their effectiveness for exploring cognitive behaviors. *Journal of the American Society for Information Science, 51*(8), 734-744.

Schamber, L., Eisenberg, M. B., & Nilan, M. S. (1990). A re-examination of relevance: Toward a dynamic, situational definition. *Information Processing & Management, 26*(6), 755-776.

Schweibenz, W. (1998). The “virtual museum”: New perspectives for museums to present objects and information. In H.H. Zimmermann & V.Schramm (Eds.), Proceedings of the *6th International Symposium on Information Science (ISI 1998),* Prague, 3–7 November, 1998. Konstanz: UVK Verlagsgesellschaft.

Semper, R. (1998). Designing hybrid environments: Integrating media into exhibition space. In S. Thomas, & A. Mintz (Eds.), *The virtual and the real: Media in the museum* (pp. 119-127). Washington: American Association of Museums.

Serola, S., & Vakkari, P. (2005). The anticipated and assessed contribution of information types in references retrieved for preparing a research proposal. *Journal of the American Society for Information Science and Technology, 56*(4), 373-381.

Skot-Hansen, D. (2008). Museerne i den danske oplevelsesøkonomi: Når oplysning bliver til en oplevelse. Frederiksberg: Imagine.

Skov, M., & Ingwersen, P. (2008). Exploring information seeking behaviour in a digital museum context. In P. Borlund, et al. (Eds.), *Information interaction in context: Proceedings of the Second International Symposium on Information Interaction in Context* (pp. 110-115). New York, NY: ACM Press.

Skov, M., Larsen, B., & Ingwersen, P. (2006). Inter and intra-document contexts applied in polyrepresentation. In I. Ruthven, P. Borlund, P. Ingwersen, N. J. Belkin, A. Tombros & P. Vakkari (Eds.), *Information Interaction in Context: International Symposium on Information Interaction in Context (IIiX 2006), Copenhagen, Denmark, 18-20 October, 2006* (pp. 163-170). New York, NY: ACM Press.

Skov, M., Larsen, B., & Ingwersen, P. (2008). Inter and intra-document contexts applied in polyrepresentation for best match IR. *Information Processing & Management, 44*(5), 1673-1683.

Sonnenwald, D. H., & Pierce, L. G. (2000). Information behavior in dynamic group work contexts: Interwoven situational awareness, dense social networks and contested collaboration in command and control. *Information Processing and Management, 36*(3), 461-479.

Stake, R. E. (2000). Case studies. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2. edition ed., pp. 435-454). London: Sage Publications.

Stebbins, R. A. (1982). Serious leisure: A conceptual statement. *Pacific Sociological Review, 25*(2), 251-272.

Stebbins, R. A. (1994). The liberal arts hobbies: A neglected subtype of serious leisure. *Society and Leisure, 17*(1), 173-186.

Stebbins, R. A. (2003). Hobbies. *Encyclopedia of leisure and outdoor recreation*. London: Routledge.

Stebbins, R. A. (2007). *Serious leisure: A perspective for our time*. New Brunswick, NJ: Transaction Publishers.

Stephenson, C. (1999). Recent developments in cultural heritage image databases: Directions for user-centered design. *Library Trends, 48*(2), 410-37.

Stone, S. (1980). CRUS humanities research programme. In S. Stone (Ed.), *Humanities information research: Proceedings of a seminar, Sheffield, 1980* (pp. 15-26). Sheffield, UK: University of Sheffield.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). London: Sage Publications.

Talja, S. (1997). Constituting "information" and "user" as research objects: A theory of knowledge formations as an alternative to the information man-theory. In P. Vakkari, R. Savolainen & B. Dervin (Eds.), *Information seeking in context: Proceedings of an international conference of research in information needs, seeking and use in different contexts.Tampere, Finland, 1997* (pp. 67-80). London: Taylor Graham Publishing.

Talja, S., Keso, H., & Pietiläinen, T. (1999). The production of 'context' in information seeking research: A metatheoretical view. *Information Processing & Management, 35*, 751-763.

Talja, S., & Maula, H. (2003). Reasons for the use and non-use of electronic journals and databases. *Journal of Documentation, 59*(6), 673-691.

Taylor, A. G. (2004). *The organization of information*. Westport, Conn: Libraries Unlimited.

Taylor, R. S. (1968). Question-negotiation and information seeking in libraries. *College and Research Libraries, 29*, 178-194.

Taylor, R. S. (1991). Information use environments. In B. Dervin, & M. J. Voigt (Eds.), *Progress in communication sciences* (pp. 217-255). Norwood, NJ: Ablex.

Thomas, W. A., & Carey, S. (2005). Actual/virtual visits: What are the links. In J. Trant, & D. Bearman (Eds.), *Museums and the Web 2005: Proceedings*. Toronto, Canada: Archives and Museum Informatics.

Tibbo, H. R. (1993). *Abstracting, information retrieval and the humanities: Providing access to historical literature*. Chicago: American Library Association.

Tibbo, H. R. (2002). Primarily history: Historians and the search for primary source materials. *Proceedings of the 2nd Joint Cconference on Digital Libraries (JCDL), July 13-17, 2002, Portland, Oregon*. New York, NJ: ACM.

Tøjhusmuseet. (2005). Krig og menneske: Koncept for ny permanent udstiling på Tøjhusmuseet [War and man: Outline for a new permanent exhibition at the Royal Danish Arsenal Museum].

Tombros, A., Ruthven, I., & Jose, J. M. (2005). How users assess web pages for information seeking. *Journal of the American Society for Information Science and Technology, 56*(4), 327-344.

Toms, E. G. (1999). What motivates the browser? In T. Wilson, & D. K. Allen (Eds.), *Exploring the contexts of information behaviour: Proceedings of the second International Conference on Research in Information Needs, Seeking and Use in Different Contexts, 13-15 August, 1998, Sheffield, UK* (pp. 191-207). London, UK: Taylor Graham.

Toms, E. G., & Duff, W. (2002). "I spent 1⁄2 hours sifting through one large box....": Diaries as information behavior of the archives user: Lessons learned. *Journal of the American Society for Information Science and Technology, 53*(14), 1232-1238.

Trant, J. (2006). Exploring the potential for social tagging and folksonomy in art museums: Proof of concept. *New Review of Hypermedia and Multimedia, 12*(1), 83-105.

Treinen, H. (1993). What does the visitor want from a museum? mass-media aspects of museology. In S. Bicknell, & G. Farmelo (Eds.), *Museum visitor studies in the 90s* (pp. 86-93). London: Science Museum.

Tudhope, D., & Binding, C. (2004). A case study of a faceted approach to knowledge organisation and retrieval in the cultural heritage sector. *DigiCULT, 6*, 28-34.

Turner, J. M., Bertrand-Gestaldy, S., & Bergeron, P. (2005). DigiCulture: A study in user behaviours with digital cultural materials in contemporary art. In J. Trant, & D. Bearman (Eds.), *Museums and the Web 2005: Proceedings*. Toronto: Archives & Museum Informatics.

Urquhart, C., Light, A., Thomas, R., Barker, A., Yeoman, A., Cooper, J., et al. (2003). Critical incident technique and explicitation interviewing in studies of information behavior. *Library and Information Science Research, 25*(1), 63-88.

Vakkari, P. (1999). Task complexity, problem structure and information actions: Intergrating studies on information seeking and retrieval. *Information Processing & Management, 35*, 819-837.

Vakkari, P. (2000a). Cognition and changes of search terms and tactics during task performance: A longitudinal case study. *Proceedings of the RIAO 2000 Conference* (pp. 894-907). Paris: CID.

Vakkari, P. (2000b). Relevance and contributory information types of searched documents in task performance. *Proceedings of the 23rd ACM SIGIR Conference* (pp. 2-9). New York: ACM.

Vakkari, P. (2001a). Changes in search tactics and relevance judgements when preparing a research proposal: A summary of the findings of a longitudinal study. *Information Retrieval, 4*(3), 295-310.

Vakkari, P. (2001b). A theory of the task-based information retrieval process: A summary and generalization of a longitudinal study. *Journal of Documentation, 57*(1), 44-60.

Vakkari, P. (2003). Task based information searching. In B. Cronin (Ed.), *Annual Review of Information Science and Technology* (vol. 37, pp. 413-464). Medford, NJ: Information Today.

Vakkari, P., & Hakala, N. (2000). Changes in relevance criteria and problem stages in task performance. *Journal of Documentation, 56*(5), 540-562.

Vakkari, P., Pennanen, M., & Serola, S. (2003). Changes of search terms and tactics while writing a research proposal: A longitudinal case study. *Information Processing and Management, 39*(3), 445-463.

Vatanen, I., Lehtonen, H., & Uotila, K. (2006). Needs of a professional, needs of the public. *The Proceedings of the Workshop 9: Archäologie Und Computer. Stadtarchäologie Wien*, Wien.

Vaughan, L. (2001). *Statistical methods for the information professional: A prcatical, painless approach to understanding, using, and interpreting statistics*. Medford, NJ: Information Today.

Vickery, B. (1997). Metatheory and information science. *Journal of Documentation, 53*(5), 457-476.

Wang, P. (1997). Users' information needs at different stages of a research project: A cognitive view. In P. Vakkari, R. Savolainen & B. Dervin (Eds.), *Information seeking in context: Proceedings of an International Conference on research in information needs, seeking and use in different context, 14-16 August, Tampere, Finland* (pp. 307-318). London: Taylor Graham.

Wang, P. (1999). Methodologies and methods for user behavioral research. In M. E. Williams (Ed.), *Annual Review of Information Science and Technology (ARIST),* (vol. 34, pp. 53-99). Medford, NJ: Information Today.

Warner, E., Murray, A. D., & Palmour, V. E. (1973). Information needs of urban citizens: Final report. Washington, DC: U.S. Department of Health, Education and Welfare, Office of Education, Bureau of Libraries and Learning Resources.

Watson-Boone, R. (1994). The information needs and habits of humanities scholars. *RQ: Reference Quarterly, 34*(2), 203-215.

Weil, S. E. (2002). *Making museums matter*. Washington: Smithsonian Institution Press.

White, L. (2004). Museum informatics: Collections, people, access, use. *Bulletin of the American Society for Information Science and Technology, 30*(5), 9-20.

White, R. W., Jose, J. M., & Ruthven, I. (2006). An implicit feedback approach for interactive information retrieval. *Information Processing and Management, 42*(1), 166-190.

White, R. W., Kules, B., Drucker, S. M., & Schraefel, M. C. (2006). Supporting exploratory search. *Communications of the ACM, 49*(4), 37-39.

White, R. W., Muresan, G., & Marchionini, G. (2006). Evaluating exploratory search systems. *Workshop on Evaluating Exploratory Search Systems (EEES 2006) at SIGIR'06.*

Wiberley, S. E., & Jones, W. G. (2000). Time and technology: A decade-long look at humanists' use of electronic information technology. *College and Research Libraries, 61*(5), 421-431.

Wildemuth, B., Jacob, E., Fullington, A., de Blieck, R., & Friedman, C. (1991). A detailed analysis of end-user serach behaviours. In J. M. Griffiths (Ed.), *Proceedings of the 54th Annual Meeting of the American Society for Information Science* (pp. 302-312). Medford, NJ: Learned Information.

Williamson, K. (1998). Discovered by chance: The role of incidental information acquisition in an ecological model of information use. *Library and Information Science Research, 20*(1), 23-40.

Wilson, T. D. (1981). On user studies and information needs. *Journal of Documentation, 37*(1), 3-15.

Wilson, T. D. (1984). The cognitive approach to information-seeking behaviour and information use. *Social Science Information Studies, 4*, 197-204.

Wilson, T. D. (1999). Exploring models of information behaviour: The 'uncertainty' project. *Information Processing and Management, 35*(6), 839-849.

Wilson, T. D. (2000). Human information behaviour. *Informing Science, 3*(2), 49-55.

Wilson, T. D. (2004). Talking about the problem: A content analysis of pre-search interviews. *Information Research, 10*(1), 1-12.

Witcomb, A. (2007). The materiality of virtual technologies: A new approach to thinking about the impact of multimedia in museums. In F. Cameron, & S. Kenderdine (Eds.), *Theorizing digital cultural heritage: A critical discourse.* (pp. 35-48). Cambridge: MIT Press.

Yakel, E. (2004). Seeking information, seeking connections, seeking meaning: Genealogists and family historians. *Information Research, 10*(1), 10-11.

Zach, L. (2005). When is “enough” enough? Modeling the information-seeking and stopping behavior of senior arts administrators. *Journal of the American Society for Information Science and Technology, 56*(1), 23-35.

Zhang, Y. (2000). Using the internet for survey research: A case study. *Journal of the American Society for Information Science, 51*(1), 57-68.

List of abbreviations

ASK	Anomalous state of knowledge
ELIS	Everyday life information seeking
IR	Information retrieval
IS&R	Information seeking and retrieval
IT	Information technology

Appendices

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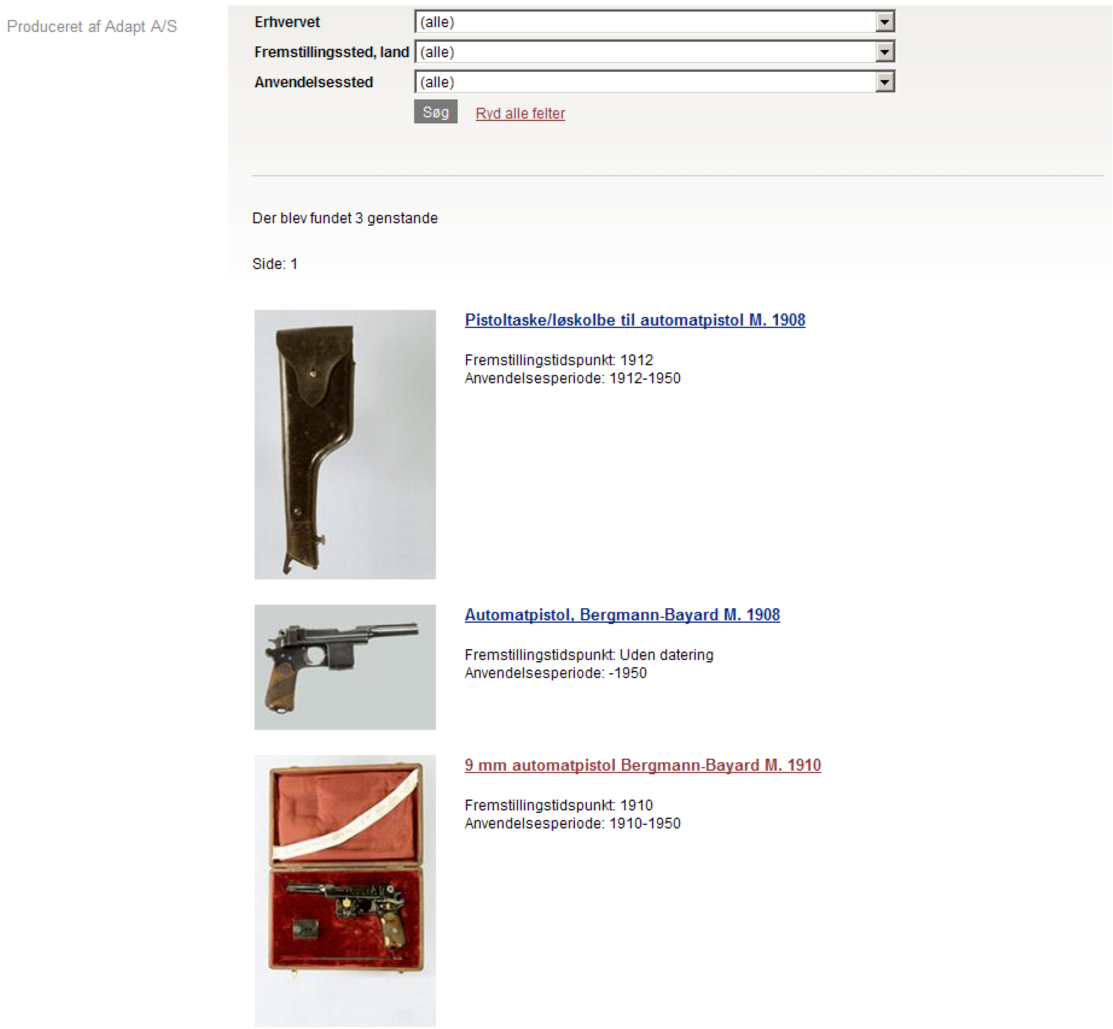
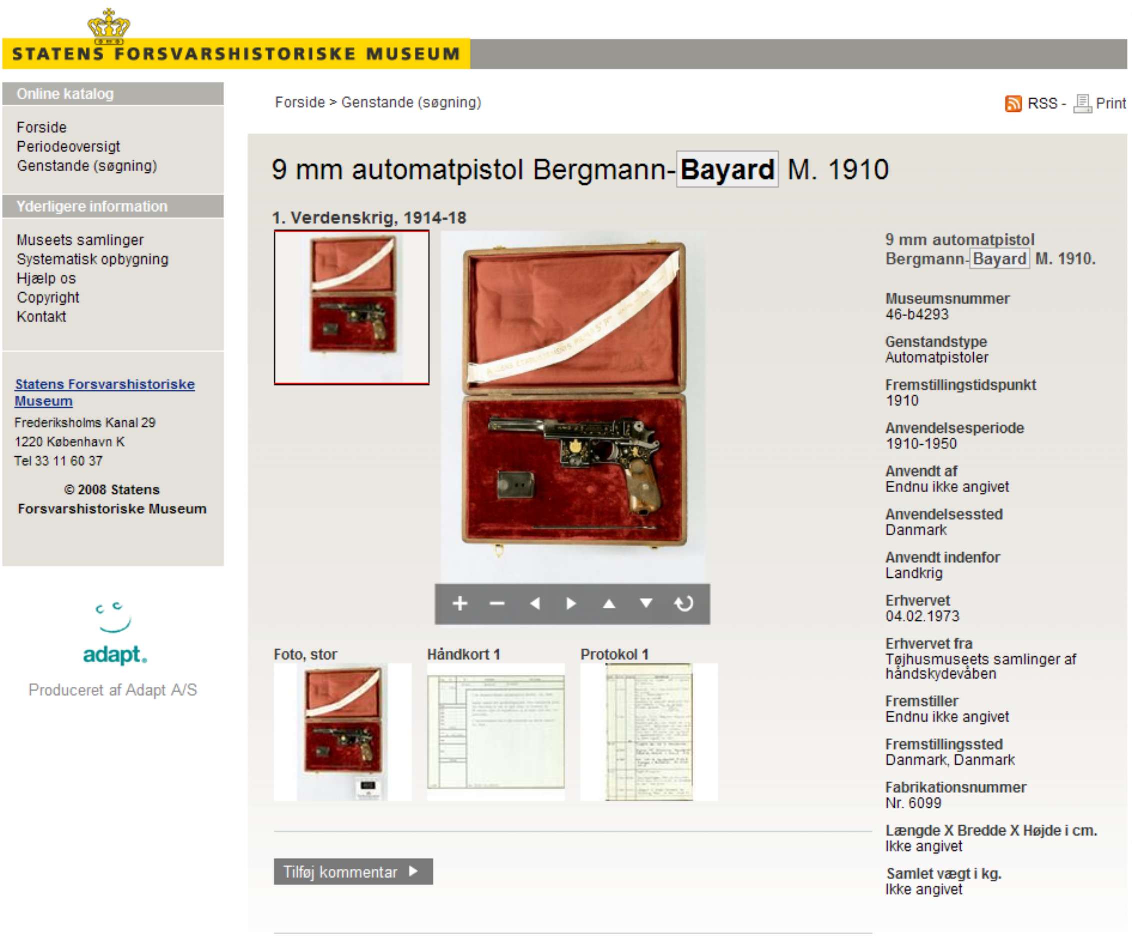
Appendix 1: Screenshot from the Military Museum's online catalogue: example of result list



Appendix 2: Screenshot from the Military Museum's online catalogue: example of a record



Appendix 3: Interview guide – professional museum curators

The appendix depicts the interview guide applied for the interviews with museum curators at the Military Museum.

Introduction:

[Short introduction explaining the outline and purpose of the interview.]

Overview of different object-related work tasks

1) What are your main object-related work tasks?
2) Provide an example of a recent object-related work task where a need for information was encountered.
3) [Ask for more examples]

Critical incident(s)

A) Complexity of object-related work task:

4) Describe the work task XX and its sub-tasks in detail
5) How would you describe the complexity of this work task? Is it a highly complex and unique task *or* a routine task?
6) What is your experience in solving this kind of work task?
7) How frequent is this task?
8) Describe the duration of the work task (sub-tasks)
9) How important is this task to you?
10) What is your ambition level in connection with this task?

B) Derived information need and type of information needed

11) What information were you looking for?
12) Did you find the information you needed? If no – why?
13) How was the information useful to you?

C) Use of information sources

14) Which information sources did you use to help find relevant information? Please name specific sources. [Prompt sources if necessary]

15) Why did you choose these sources?

16) Was there any information that you did not find?

[Prompt, if the museum's documentation is not mentioned as a source] Did you consider using the museum's documentation? Why/why not?

[If more than one critical incident then the questions are repeated for each critical incident]

Closure

Ask whether the interviewee has something to add.

Thank you for participating.

Appendix 4: English version of web questionnaire

The appendix depicts a textual version (in English) of the web questionnaire. The web questionnaire (in Danish) can by found by following this link: http://kalus3.kalus.dk/a?e=kMEFvSwTHsD9.

Please help us! We need your help to answer this questionnaire about your visit to the Military Museum's web site. It takes 5-10 minutes. The questionnaire is part of a research project on virtual museum visitors.
Respondents can participate in a drawing lot and win a 1 GB memory stick and a season ticket to the museum.
If you don't have time to complete the questionnaire right now you are welcome to return at a later point – however, please return before the 14th of April 2008. All responses are treated anonymously.
Click the 'start' button to begin the questionnaire.

Question 1 – frequency of visit
How often have you visited the Military Museum's web site?
1. This is the first time
2. I have visited the web site a couple of times (1-5 times)
3. I have often visited the web site (more than five times)
4. I don't know

Question 2 – connection of visit
In what connection do you visit the Military museum's web site?
1. School or study visit
2. Hobby or leisure interest
3. Work
4. I'm preparing a visit to the museum
5. By coincidence
6. Other – please specify

Question 3 – describe your area of work
(Contingency question – only shown if question 2.3 is marked)
1. News media / publishing
2. Museums
3. Other cultural heritage institutions
4. Educational or research institution
5. The Danish defence or civil guard
6. Other please specify

Question 4 – describe your hobby
(Contingency question – only shown if question 2.2 is marked)
Describe your hobby that relates to your visit at the Military Museum's web site? (Respondents have a choice to select all that apply)
1. Defence and military history in general
2. Specific period of defence and military history (e.g., the period of King Christian the fourth or 1800-century).
3. Specific defence and military history event (e.g., the Second World War or 'Slaget på Reden'(the name of a famous sea battle))
4. A specific object type (e.g., hand weapons, war ships, or uniforms)
5. History in general within a time period (e.g., the renaissance or the period during the Cold War)
6. Genealogy or family history
7. Local history
8. Re-enactment
9. Military miniaturism
10. Other – please specify

Question 5 – Level of education
(Contingency question – only shown if question 2.1 is marked)
Indicate the level of your study:
1. Elementary school
2. Basic training at apprentice level (e.g., carpenter, office clerk, hairdresser)
3. High school
4. Short, higher education
5. University – bachelor level
6. University – master level
7. Other – please specify
8. I don't know

Question 6 – Where do you find information?
(Contingency question – only shown if question 2.2 is marked)
(Respondents have a choice to select all that apply)
Where do you find information in relation to your hobby? (Respondents have a choice to select all that apply)
1. Family and friends
2. Other with the same hobby / area of interest
3. Public library
4. Special or research libraries
5. Archives
6. My own book collection
7. Documentary programs on TV or DVD
8. Discussion groups and/or mailing lists on the internet
9. Blogs on the internet
10. The internet in general

11. Other – please specify
12. I don’t know

Question 7 – Knowledge level
(Contingency question – only shown if question 2.2 is marked)
How would you describe your knowledge level in relation to your hobby?
1. I’m a novice and have only little knowledge within this area
2. I have some experience and background knowledge
3. I’m highly experienced and have extensive background knowledge
4. I don’t know

Question 8 – Purpose of visit to the Military Museum’s web site
(Contingency question – only shown if question 2.2 is marked)
(Respondents have a choice to select all that apply)
What is the primary purpose of your visit to the Military Museum’s web site?
1. Gain knowledge of the museum’s collections
2. Gain knowledge on defence and military history in general
3. Find a photograph or illustration
4. Find information on a specific museum object (e.g., ‘Haderslev kanonen’ (a specific canon from the Second World War) or captain B. Jensen’s uniform jacket)
5. Find information on a specific type of museum object (e.g., the Madsen machine gun or a flint lock weapon)
6. Prepare a visit to the museum
7. Find links to literature
8. Other – please specify
9. I don’t know

Question 9 – Visit outcome
(Contingency question – only shown if question 2.2 is marked)
Did you find what you was looking for on the Military Museum’s web site?
1. Yes, I found what I was looking for
2. I found some of what I was looking for. But I couldn’t find: ________________
3. I didn’t find what I was looking for. I couldn’t find: ________________________
4. I was not looking for anything specific
5. I don’t know

Question 10 – Object related information
(Contingency question – only shown if question 2.2 is marked)
(Respondents have a choice to select all that apply)
What object related information is relevant to you?
1. Physical description and measurements of the object
2. Photograph of object
3. Production year
4. Type of object (e.g., edged weapon, bayonet, or flint lock muskets)
5. Who owned and/or used the object
6. When was the object used

7. In which historic events was the object used (e.g., wars or battles)
8. In which countries was the object used
9. Historic information on periods or events associated to the object
10. Short prose description of the object (50-70 words, a few sentences)
11. Long prose description of the object (70-200 words)
12. Country of production
13. References to further information on the object
14. Other – please specify
15. I don't know

Question 11 – Educational background
(Contingency question – only shown if question 2.2 is marked)
What is your educational background?
1. Elementary school
2. Erhvervsfaglig
3. High school
4. Short eduction, e.g., technical training
5. Bachelor level
6. Master university level
7. Other – please specify
8. I don't know / I prefer not to answer

Question 12 – Occupation
(Contingency question – only shown if question 2.2 is marked)
What is your occupation?
1. Private sector (lower level)
2. Private sector (higher level)
3. Public sector (lower level)
4. Public sector (higher level)
5. Self-employed
6. Student
7. Unemployed
8. Retired
9. Other
10. I don't know / I prefer not to answer

Question 13 – Age and sex
How old are you: _______ years
Sex: Male ______ Female ______

Question 14 – Would you like to participate in a user study?
(Contingency question – only shown if question 2.2 is marked)
This questionnaire is part of a research project on virtual museum visitors and how museum objects and collections are best presented on the internet. We would like your help to participate in a user study including an interview. The user study takes about one

hour. All participants will receive an incentive – a 1 GB memory stick and a season card to the Military Museum.
1. I would like to participate or receive further information on the user study
2. I'm not interested in participating

Question 15 – Name and e-mail address
(Contingency question – only shown if question 14.1 is marked)
Thank you for showing interest in the user study. Please write your name and e-mail address and you will be contacted as soon as possible.
Name: ___________________________________
E-mail address: ____________________________

Thank you for your response!
There are no more questions. You can edit your response by clicking "previous site". Please, click 'finish' to end the questionnaire.

Again, thank you for filling in the questionnaire. You can win a 1 GB memory stick. Send your name and address to ms@db.dk if you want to participate in the drawing lot. All information will be kept in confidence and deleted afterwards.

If you have further comments or questions regarding the research project, please contact:

Mette Skov, PhD student
Royal School of Library and Information Science /
The Military Museum
E-mail: ms@db.dk
Phone: 32 58 60 66

Appendix 5: Invitation to participate in user study on virtual museum visitors

The appendix depicts the invitation to participate in the user study on virtual museum visitors. The invitation was published in Våbenhistorisk Tidsskrift, January 2008.

Deltagere til undersøgelse efterlyses

Hvordan formidles museumsgenstande og samlinger bedst på internettet? Og hvem er den virtuelle museumsgæst? Dette skal en ny undersøgelse være med til at belyse, og samtidigt skal oplysningerne anvendes til at videreudvikle Statens Forsvarshistoriske Museums hjemmeside. Undersøgelsen er en del af et forskningsprojekt om virtuelle museumsgæster.

Vi har brug for din hjælp og efterlyser derfor deltagere til en undersøgelse, som finder sted i februar. Eneste forudsætning for at deltage i undersøgelsen er, at du har besøgt Tøjhusmuseet eller Orlogsmuseet hjemmeside og er interesseret i dansk forsvarshistorie.

Hvis du har lyst til at deltage eller ønsker yderligere information, bedes du kontakte mig på e-mail ms@db.dk eller telefon 32 34 13 67.

Med venlig hilsen

Mette Skov, ph.d. stipendiat
Danmarks Biblioteksskole *og*
Statens Forsvarshistoriske Museum

Appendix 6: Email to potential user study participants

The appendix depicts an example of an email sent to potential user study participants. It was sent to questionnaire respondents who had agreed to be informed about / participate in the user study.

Kære ______________

Tak for din besvarelse af spørgeskemaet på Tøjhusmuseets hjemmeside. Du oplyser i spørgeskemaet, at du gerne vil høre nærmere om / deltage i en brugerundersøgelse. Nedenfor er yderligere information om undersøgelsen.

Undersøgelsen er en del af et forskningsprojekt om virtuelle museumsgæster og hvordan museumsgenstande og samlinger bedst formidles på internettet. Undersøgelsen består af to dele. Første del foregår foran en computer og er en del af en evaluering af Statens Forsvarshistoriske Museums online-katalog over museumsgenstande. Det kræver ingen forudgående kendskab fra din side. Anden del af undersøgelsen er et interview omkring din interesse i militær- og/eller forsvarshistorie. Samlet tager undersøgelsen cirka 1½ time). Som tak for din deltagelse i undersøgelsen får du en 1 GB memory stick samt et årskort til museet.

Brugerundersøgelsen foregår i Statens Forsvarshistoriske Museums administrationsbygning (Frederiksholms Kanal 29 i København), og hvis du er interesseret i at deltage, er du velkommen til at foreslå et tidspunkt i løbet af februar eller marts måned, som passer dig. Hvis du ikke har mulighed for at komme ind på museet, kan brugerundersøgelsen eventuelt gennemføres et andet sted.

Du er naturligvis velkommen til at stille yderligere spørgsmål. Jeg er nemmest at træffe på denne e-mail, men jeg kan også træffes på nedenstående telefonnummer. Jeg håber at høre fra dig.

Med venlig hilsen

Mette Skov

Ph.d. stipendiat

Danmarks Biblioteksskole og Statens Forsvarshistoriske Museum
Tel direkte 33 18 14 38 (Statens Forsvarshistoriske Museum)
Tel direkte 32 34 13 67 (Danmarks Biblioteksskole)
E-mail: ms@db.dk
www.db.dk/ms

Appendix 7: Combined observation protocol and interview guide

Observations during simulated search sessions (user study par I):

A. Search session A start:

B. Search session A end:

C. Presence or absence of different search strategies: Browsing or querying or combination ____

D. Aspects the participant should be asked to comment during the retrospective think-aloud session:

____

____

____

____

____

During retrospective-think aloud sessions (user study part I):

A. Why did you choose to query / browse?
B. How did you decide which records to open/view?
C. What data elements are important in this search task?
D. During the task, what information was interesting/new/relevant?
E. Did you miss any information? If yes, which?
F. Time stamps for interesting quotes:

Interview guide regarding virtual museum visitors (user study part II):

1. *Characteristic of hobby/area of interest.*
   In the web survey you answered that your hobby is xx. Please tell about your hobby / interest area beginning with how you got interested and ending with your present area of interest.

2. *Critical incident.*
   A. What was the purpose of your visit to the Military Museum's online catalogue the day you found and filled in the web questionnaire?
   B. Did you find what you were looking for? If not, what might be the reason? (Ask for detailed information on the answers provided in question 8 and 9 in the online survey). And if not, did you find the information elsewhere?
   C. Which data elements were (most) helpful for you (when seeking information for the needs of the critical incident)? Why were they particularly helpful?
   D. What was the information used for?

3. *Information sources and channels (in general – not specifically related the critical incident).*
   In the web questionnaire you answered that you use information sources x and y. Can you give some examples?
   In general, what do you do to learn more about hobby?

4. *Information sharing and use (in general – not specifically related the critical incident).*
   What do you do with the obtained information?
   How do you share your knowledge on your hobby with others - if at all? (Face to face, news groups, write articles, etc.).

Appendix 8: Test of associations between respondents' hobby and age

Calculation of Chi-square test for associations between variables in questionnaire question number 4, "describe your hobby" and "age".

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Defence and military history in general * Age. Crosstab

Defence and military history in general		Age		
		Younger	Older	Total
0	Count	31	25	56
	Expected Count	29,3	26,7	56,0
	% within Defence and military hist general	55,4%	44,6%	100,0%
1	Count	38	38	76
	Expected Count	39,7	36,3	76,0
	% within Defence and military hist general	50,0%	50,0%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Defence and military hist general	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,371[a]	1	,543
N of Valid Cases	132		

b. Computed only for a 2x2 table

Specific period of defence and mil history * Age. Crosstab

Specific period of defence and military history		Age		
		Younger	Older	Total
0	Count	60	51	111
	Expected Count	58,0	53,0	111,0
	% within Specific period of defence and mil history	54,1%	45,9%	100,0%
1	Count	9	12	21
	Expected Count	11,0	10,0	21,0
	% within Specific period of defence and mil history	42,9%	57,1%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Specific period of defence and mil history	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,887[a]	1	,346
N of Valid Cases	132		

b. Computed only for a 2x2 table

Specific historic event * Age. Crosstab

Specific historic event		Age		
		Younger	Older	Total
0	Count	44	46	90
	Expected Count	47,0	43,0	90,0
	% within Specfic historic event	48,9%	51,1%	100,0%
1	Count	25	17	42
	Expected Count	22,0	20,0	42,0
	% within Specfic historic event	59,5%	40,5%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Specfic historic event	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,298[a]	1	,255
N of Valid Cases	132		

b. Computed only for a 2x2 table

A specific object type * Age. Crosstab

A specific object type		Age Younger	Older	Total
0	Count	28	23	51
	Expected Count	26,7	24,3	51,0
	% within A specific object type	54,9%	45,1%	100,0%
1	Count	41	40	81
	Expected Count	42,3	38,7	81,0
	% within A specific object type	50,6%	49,4%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within A specific object type	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,230[a]	1	,631
N of Valid Cases	132		

b. Computed only for a 2x2 table

History in general within a time period * Age. Crosstab

History in general within a time period		Age Younger	Older	Total
0	Count	62	54	116
	Expected Count	60,6	55,4	116,0
	% within History in general within a time period	53,4%	46,6%	100,0%
1	Count	7	9	16
	Expected Count	8,4	7,6	16,0
	% within History in general within a time period	43,8%	56,2%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within History in general within a time period	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,530[a]	1	,467
N of Valid Cases	132		

b. Computed only for a 2x2 table

Genealogy or family history * Age. Crosstab

Genealogy or family history		Age		
		Younger	Older	Total
0	Count	69	58	127
	Expected Count	66,4	60,6	127,0
	% within Genealogy or family history	54,3%	45,7%	100,0%
1	Count	0	5	5
	Expected Count	2,6	2,4	5,0
	% within Genealogy or family history	,0%	100,0%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Genealogy or family history	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,692[a]	1	,017
N of Valid Cases	132		

b. Computed only for a 2x2 table

Local history * Age. Crosstab

Local history		Age		
		Younger	Older	Total
0	Count	67	59	126
	Expected Count	65,9	60,1	126,0
	% within Local history	53,2%	46,8%	100,0%
1	Count	2	4	6
	Expected Count	3,1	2,9	6,0
	% within Local history	33,3%	66,7%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Local history	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,904[a]	1	,342
N of Valid Cases	132		

b. Computed only for a 2x2 table

Re-enactment * Age. Crosstab

Re-enactment		Age		
		Younger	Older	Total
0	Count	61	61	122
	Expected Count	63,8	58,2	122,0
	% within Re-enactment	50,0%	50,0%	100,0%
1	Count	8	2	10
	Expected Count	5,2	4,8	10,0
	% within Re-enactment	80,0%	20,0%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Re-enactment	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,334[a]	1	,058
N of Valid Cases	132		

b. Computed only for a 2x2 table

Military miniaturism * Age. Crosstab

Military miniaturism		Age		
		Younger	Older	Total
0	Count	62	61	123
	Expected Count	64,3	58,7	123,0
	% within Military miniaturism	50,4%	49,6%	100,0%
1	Count	7	2	9
	Expected Count	4,7	4,3	9,0
	% within Military miniaturism	77,8%	22,2%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Military miniaturism	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,518[a]	1	,113
N of Valid Cases	132		

b. Computed only for a 2x2 table

Appendix 9: Test of associations between respondents' hobby and knowledge level

Calculation of Chi-square test for associations between variables in questionnaire question number 4, "describe your hobby" and "knowledge level".

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Defence and military history in general * Knowledge level

Defence and military history in general		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	7	29	19	1	56
	Expected Count	5,9	32,2	17,0	,8	56,0
	% within Defence and military history in general	12,5%	51,8%	33,9%	1,8%	100,0%
1	Count	7	47	21	1	76
	Expected Count	8,1	43,8	23,0	1,2	76,0
	% within Defence and military history in general	9,2%	61,8%	27,6%	1,3%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Defence and military history in general	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,364[a]	3	,714
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,85.

Specific period of defence and military history * Knowledge level. Crossstab

Specific period of defence and mil history		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	14	66	30	1	111
	Expected Count	11,8	63,9	33,6	1,7	111,0
	% within Specific period…	12,6%	59,5%	27,0%	,9%	100,0%
1	Count	0	10	10	1	21
	Expected Count	2,2	12,1	6,4	,3	21,0
	% within Specific period…	,0%	47,6%	47,6%	4,8%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Specific period…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7,287[a]	3	,063
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,32.

Specific historic event * Knowledge level. Crosstab

Specific historic event		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	14	49	26	1	90
	Expected Count	9,5	51,8	27,3	1,4	90,0
	% within Specfic historic event	15,6%	54,4%	28,9%	1,1%	100,0%
1	Count	0	27	14	1	42
	Expected Count	4,5	24,2	12,7	,6	42,0
	% within Specfic historic event	,0%	64,3%	33,3%	2,4%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Specfic historic event	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7,506[a]	3	,057
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,64.

A specific object type * Knowledge level. Crosstab

A specific object type		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	8	31	12	0	51
	Expected Count	5,4	29,4	15,5	,8	51,0
	% within A specific object type	15,7%	60,8%	23,5%	,0%	100,0%
1	Count	6	45	28	2	81
	Expected Count	8,6	46,6	24,5	1,2	81,0
	% within A specific object type	7,4%	55,6%	34,6%	2,5%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within A specific object type	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,689[a]	3	,196
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,77.

History in general within a time period * Knowledge level. Crosstab

History in general within a time period		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	13	67	34	2	116
	Expected Count	12,3	66,8	35,2	1,8	116,0
	% within History in general…	11,2%	57,8%	29,3%	1,7%	100,0%
1	Count	1	9	6	0	16
	Expected Count	1,7	9,2	4,8	,2	16,0
	% within History in general…	6,2%	56,2%	37,5%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within History in general…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,918[a]	3	,821
N of Valid Cases	132		

a. 4 cells (50,0%) have expected count less than 5. The minimum expected count is ,24.

Genealogy or family history * Knowledge level. Crosstab

Genealogy or family history		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	14	72	39	2	127
	Expected Count	13,5	73,1	38,5	1,9	127,0
	% within Genealogy…	11,0%	56,7%	30,7%	1,6%	100,0%
1	Count	0	4	1	0	5
	Expected Count	,5	2,9	1,5	,1	5,0
	% within Genealogy…	,0%	80,0%	20,0%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Genealogy…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,266[a]	3	,737
N of Valid Cases	132		

a. 5 cells (62,5%) have expected count less than 5. The minimum expected count is ,08.

Local history * Knowledge level. Crosstab

Local history		Knowledge level: Novice	Some experience	Highly experienced	I don't know	Total
0	Count	13	73	38	2	126
	Expected Count	13,4	72,5	38,2	1,9	126,0
	% within Local history	10,3%	57,9%	30,2%	1,6%	100,0%
1	Count	1	3	2	0	6
	Expected Count	,6	3,5	1,8	,1	6,0
	% within Local history	16,7%	50,0%	33,3%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Local history	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,395[a]	3	,941
N of Valid Cases	132		

a. 5 cells (62,5%) have expected count less than 5. The minimum expected count is ,09.

Re-enactment * Knowledge level. Crosstab

Re-enactment		Knowledge level: Novice	Some experience	Highly experienced	I don't know	Total
0	Count	13	69	38	2	122
	Expected Count	12,9	70,2	37,0	1,8	122,0
	% within Re-enactment	10,7%	56,6%	31,1%	1,6%	100,0%
1	Count	1	7	2	0	10
	Expected Count	1,1	5,8	3,0	,2	10,0
	% within Re-enactment	10,0%	70,0%	20,0%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Re-enactment	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,837[a]	3	,841
N of Valid Cases	132		

a. 4 cells (50,0%) have expected count less than 5. The minimum expected count is ,15.

Military miniaturism * Knowledge level. Crosstab

Military miniaturism		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	13	70	38	2	123
	Expected Count	13,0	70,8	37,3	1,9	123,0
	% within Military miniaturism	10,6%	56,9%	30,9%	1,6%	100,0%
1	Count	1	6	2	0	9
	Expected Count	1,0	5,2	2,7	,1	9,0
	% within Military miniaturism	11,1%	66,7%	22,2%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Military miniaturism	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,495[a]	3	,920
N of Valid Cases	132		

a. 4 cells (50,0%) have expected count less than 5. The minimum expected count is ,14.

Appendix 10: Test of associations between respondents' age and knowledge level

Calculation of Chi-square test for associations between questionnaire question number 7, "knowledge level" and "age".

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Age * Knowledge level. Crosstab

Age		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
Young	Count	12	42	13	2	69
	Expected Count	7,3	39,7	20,9	1,0	69,0
	% within Age	17,4%	60,9%	18,8%	2,9%	100,0%
Old	Count	2	34	27	0	63
	Expected Count	6,7	36,3	19,1	1,0	63,0
	% within Age	3,2%	54,0%	42,9%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Age	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14,642[a]	3	,002
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,95.

Appendix 11: Test of associations between respondents' purpose of visit and type of hobbyists

Calculation of Chi-square test for associations between questionnaire question number 8, "purpose of visit [at the museum's web site]" and "type of hobbyists".

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Gain knowledge of collections * Type of hobbyist. Crosstab

Gain knowledge of collections		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	50	23	73
	Expected Count	51,4	21,6	73,0
	% within Gain knowledge of collections	68,5%	31,5%	100,0%
1	Count	43	16	59
	Expected Count	41,6	17,4	59,0
	% within Gain knowledge of collections	72,9%	27,1%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Gain knowledge of collections	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,302[a]	1	,583
N of Valid Cases	132		

b. Computed only for a 2x2 table

Gain knowledge of military history * Type of hobbyist. Crosstab

Gain knowledge of military history		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	61	17	78
	Expected Count	55,0	23,0	78,0
	% within Gain knowledge of mil hist	78,2%	21,8%	100,0%
1	Count	32	22	54
	Expected Count	38,0	16,0	54,0
	% within Gain knowledge of mil hist	59,3%	40,7%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Gain knowledge of mil hist	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,502[a]	1	,019
N of Valid Cases	132		

b. Computed only for a 2x2 table

Find photograph * Type of hobbyist. Crosstab

Find photograph		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	42	24	66
	Expected Count	46,5	19,5	66,0
	% within Find photograph	63,6%	36,4%	100,0%
1	Count	51	15	66
	Expected Count	46,5	19,5	66,0
	% within Find photograph	77,3%	22,7%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Find photograph	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,948[a]	1	,086
N of Valid Cases	132		

b. Computed only for a 2x2 table

Find information on specific object * Type of hobbyist. Crosstab

Find info on specific object		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	52	33	85
	Expected Count	59,9	25,1	85,0
	% within Find info on specific object	61,2%	38,8%	100,0%
1	Count	41	6	47
	Expected Count	33,1	13,9	47,0
	% within Find info on specific object	87,2%	12,8%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Find info on specific object	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9,872[a]	1	,002
N of Valid Cases	132		

b. Computed only for a 2x2 table

Find information on specific type of object * Type of hobbyist. Crosstab

Find info on specific type of object		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	28	24	52
	Expected Count	36,6	15,4	52,0
	% within Find info on specific type of obj	53,8%	46,2%	100,0%
1	Count	65	15	80
	Expected Count	56,4	23,6	80,0
	% within Find info on specific type of obj	81,2%	18,8%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Find info on specific type of obj	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11,370[a]	1	,001
N of Valid Cases	132		

b. Computed only for a 2x2 table

Prepare a visit * Type of hobbyist. Crosstab

Prepare a visit		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	75	29	104
	Expected Count	73,3	30,7	104,0
	% within Prepare a visit	72,1%	27,9%	100,0%
1	Count	18	10	28
	Expected Count	19,7	8,3	28,0
	% within Prepare a visit	64,3%	35,7%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Prepare a visit	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,650[a]	1	,420
N of Valid Cases	132		

b. Computed only for a 2x2 table

Find links to literature * Type of hobbyist. Crosstab

Find links to literature		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	78	36	114
	Expected Count	80,3	33,7	114,0
	% within Find links to literature	68,4%	31,6%	100,0%
1	Count	15	3	18
	Expected Count	12,7	5,3	18,0
	% within Find links to literature	83,3%	16,7%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Find links to literature	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,661[a]	1	,198
N of Valid Cases	132		

b. Computed only for a 2x2 table

Appendix 12: Test of associations between respondents' age *and* preferred data elements

Calculation of Chi-square test for associations between variables in questionnaire question number 10, "object related information" and "age".

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Physical description * Age. Crosstab

Physical description		Age		
		Younger	Older	Total
0	Count	22	24	46
	Expected Count	24,0	22,0	46,0
	% within Physical description	47,8%	52,2%	100,0%
1	Count	47	39	86
	Expected Count	45,0	41,0	86,0
	% within Physical description	54,7%	45,3%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Physical description	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,560[a]	1	,454
N of Valid Cases	132		

b. Computed only for a 2x2 table

Photo of object * Age. Crosstab

Photo of object		Age		
		Younger	Older	Total
0	Count	9	5	14
	Expected Count	7,3	6,7	14,0
	% within Photo of object	64,3%	35,7%	100,0%
1	Count	60	58	118
	Expected Count	61,7	56,3	118,0
	% within Photo of object	50,8%	49,2%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Photo of object	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,906[a]	1	,341
N of Valid Cases	132		

b. Computed only for a 2x2 table

Production year * Age. Crosstab

Production year		Age		
		Younger	Older	Total
0	Count	19	22	41
	Expected Count	21,4	19,6	41,0
	% within Production year	46,3%	53,7%	100,0%
1	Count	50	41	91
	Expected Count	47,6	43,4	91,0
	% within Production year	54,9%	45,1%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Production year	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,839[a]	1	,360
N of Valid Cases	132		

b. Computed only for a 2x2 table

Type of object * Age. Crosstab

Type of object		Age		
		Younger	Older	Total
0	Count	31	33	64
	Expected Count	33,5	30,5	64,0
	% within Type of object	48,4%	51,6%	100,0%
1	Count	38	30	68
	Expected Count	35,5	32,5	68,0
	% within Type of object	55,9%	44,1%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Type of object	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,732[a]	1	,392
N of Valid Cases	132		

b. Computed only for a 2x2 table

Who owned/used the object * Age. Crosstab

Who owned/used the object		Age		
		Younger	Older	Total
0	Count	32	35	67
	Expected Count	35,0	32,0	67,0
	% within Who owned/used the object	47,8%	52,2%	100,0%
1	Count	37	28	65
	Expected Count	34,0	31,0	65,0
	% within Who owned/used the object	56,9%	43,1%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Who owned/used the object	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,110[a]	1	,292
N of Valid Cases	132		

b. Computed only for a 2x2 table

When was the object used * Age. Crosstab

When was the object used		Age Younger	Older	Total
0	Count	18	28	46
	Expected Count	24,0	22,0	46,0
	% within When was the object used	39,1%	60,9%	100,0%
1	Count	51	35	86
	Expected Count	45,0	41,0	86,0
	% within When was the object used	59,3%	40,7%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within When was the object used	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,888[a]	1	,027
N of Valid Cases	132		

b. Computed only for a 2x2 table

In which historic event was the object used * Age. Crosstab

In which historic event was the object used		Age Younger	Older	Total
0	Count	29	33	62
	Expected Count	32,4	29,6	62,0
	% within In which historic event…	46,8%	53,2%	100,0%
1	Count	40	30	70
	Expected Count	36,6	33,4	70,0
	% within In which historic event…	57,1%	42,9%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within In which historic event…	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,417[a]	1	,234
N of Valid Cases	132		

b. Computed only for a 2x2 table

In which countries was the object used * Age. Crosstab

In which countries was the object used		Age Younger	Older	Total
0	Count	29	38	67
	Expected Count	35,0	32,0	67,0
	% within In which countries…	43,3%	56,7%	100,0%
1	Count	40	25	65
	Expected Count	34,0	31,0	65,0
	% within In which countries…	61,5%	38,5%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within In which countries…	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,407[a]	1	,036
N of Valid Cases	132		

b. Computed only for a 2x2 table

Associated historic information on periods or events * Age. Crosstab

Associated historic info on periods or events		Age Younger	Older	Total
0	Count	40	46	86
	Expected Count	45,0	41,0	86,0
	% within Associated historic info…	46,5%	53,5%	100,0%
1	Count	29	17	46
	Expected Count	24,0	22,0	46,0
	% within Associated historic info…	63,0%	37,0%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Associated historic info…	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,283[a]	1	,070
N of Valid Cases	132		

b. Computed only for a 2x2 table

Short prose description * Age. Crosstab

Short prose description		Age Younger	Older	Total
0	Count	53	41	94
	Expected Count	49,1	44,9	94,0
	% within Short prose description	56,4%	43,6%	100,0%
1	Count	16	22	38
	Expected Count	19,9	18,1	38,0
	% within Short prose description	42,1%	57,9%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Short prose description	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,211[a]	1	,137
N of Valid Cases	132		

b. Computed only for a 2x2 table

Long prose description * Age. Crosstab

Long prose description		Age Younger	Older	Total
0	Count	24	33	57
	Expected Count	29,8	27,2	57,0
	% within Long prose description	42,1%	57,9%	100,0%
1	Count	45	30	75
	Expected Count	39,2	35,8	75,0
	% within Long prose description	60,0%	40,0%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Long prose description	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,157[a]	1	,041
N of Valid Cases	132		

b. Computed only for a 2x2 table

Country of production * Age. Crosstab

Country of production		Age		
		Younger	Older	Total
0	Count	32	32	64
	Expected Count	33,5	30,5	64,0
	% within Country of production	50,0%	50,0%	100,0%
1	Count	37	31	68
	Expected Count	35,5	32,5	68,0
	% within Country of production	54,4%	45,6%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Country of production	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,257[a]	1	,612
N of Valid Cases	132		

b. Computed only for a 2x2 table

References to further info on the object * Age. Crosstab

References to further info on the object		Age		
		Younger	Older	Total
0	Count	28	31	59
	Expected Count	30,8	28,2	59,0
	% within References to further info on the object	47,5%	52,5%	100,0%
1	Count	41	32	73
	Expected Count	38,2	34,8	73,0
	% within References to further info on the object	56,2%	43,8%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within References to further info on the object	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,991[a]	1	,319
N of Valid Cases	132		

b. Computed only for a 2x2 table

Appendix 13: Test of associations between respondents' knowledge level *and* preferred data elements

Calculation of Chi-square test for associations between variables in questionnaire question number 10, "object related information" and question number 7, "knowledge level".

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Physical description * Knowledge level. Crosstab

Physical description		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	7	25	14	0	46
	Expected Count	4,9	26,5	13,9	,7	46,0
	% within Physical desc. ..	15,2%	54,3%	30,4%	,0%	100,0%
1	Count	7	51	26	2	86
	Expected Count	9,1	49,5	26,1	1,3	86,0
	% within Physical desc…	8,1%	59,3%	30,2%	2,3%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Physical desc…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,614[a]	3	,455
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,70.

Photo of object * Knowledge level. Crosstab

Photo of object		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	1	10	3	0	14
	Expected Count	1,5	8,1	4,2	,2	14,0
	% within Photo of object	7,1%	71,4%	21,4%	,0%	100,0%
1	Count	13	66	37	2	118
	Expected Count	12,5	67,9	35,8	1,8	118,0
	% within Photo of object	11,0%	55,9%	31,4%	1,7%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Photo of object	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,343[a]	3	,719
N of Valid Cases	132		

a. 4 cells (50,0%) have expected count less than 5. The minimum expected count is ,21.

Production year * Knowledge level. Crosstab

Production year		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	5	22	14	0	41
	Expected Count	4,3	23,6	12,4	,6	41,0
	% within Production year	12,2%	53,7%	34,1%	,0%	100,0%
1	Count	9	54	26	2	91
	Expected Count	9,7	52,4	27,6	1,4	91,0
	% within Production year	9,9%	59,3%	28,6%	2,2%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Production year	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,491[a]	3	,684
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,62.

Type of object * Knowledge level. Crosstab

Type of object		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	5	38	21	0	64
	Expected Count	6,8	36,8	19,4	1,0	64,0
	% within Type of object	7,8%	59,4%	32,8%	,0%	100,0%
1	Count	9	38	19	2	68
	Expected Count	7,2	39,2	20,6	1,0	68,0
	% within Type of object	13,2%	55,9%	27,9%	2,9%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Type of object	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,125[a]	3	,373
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,97.

Who owned/used the object * Knowledge level. Crosstab

Who owned/used the object		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	8	41	18	0	67
	Expected Count	7,1	38,6	20,3	1,0	67,0
	% within Who owned/used the object	11,9%	61,2%	26,9%	,0%	100,0%
1	Count	6	35	22	2	65
	Expected Count	6,9	37,4	19,7	1,0	65,0
	% within Who owned/used the object	9,2%	53,8%	33,8%	3,1%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Who owned/used the object	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,130[a]	3	,372
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,98.

When was the object used * Knowledge level. Crosstab

When was the object used		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	7	22	17	0	46
	Expected Count	4,9	26,5	13,9	,7	46,0
	% within When was…	15,2%	47,8%	37,0%	,0%	100,0%
1	Count	7	54	23	2	86
	Expected Count	9,1	49,5	26,1	1,3	86,0
	% within When was…	8,1%	62,8%	26,7%	2,3%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within When was…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,682[a]	3	,197
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,70.

In which historic event was the object used * Knowledge level. Crosstab

In which historic event was the object used		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	6	33	22	1	62
	Expected Count	6,6	35,7	18,8	,9	62,0
	% within In which historic event..	9,7%	53,2%	35,5%	1,6%	100,0%
1	Count	8	43	18	1	70
	Expected Count	7,4	40,3	21,2	1,1	70,0
	% within In which historic event..	11,4%	61,4%	25,7%	1,4%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within In which historic event..	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,522[a]	3	,677
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,94.

In which countries was the object used * Knowledge level. Crosstab

In which countries was the object used		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	9	33	25	0	67
	Expected Count	7,1	38,6	20,3	1,0	67,0
	% within In which countries was…	13,4%	49,3%	37,3%	,0%	100,0%
1	Count	5	43	15	2	65
	Expected Count	6,9	37,4	19,7	1,0	65,0
	% within In which countries was…	7,7%	66,2%	23,1%	3,1%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within In which countries was…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6,930[a]	3	,074
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,98.

Associated historic info on periods or events * Knowledge level. Crosstab

Associated historic info on periods or events		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	9	49	27	1	86
	Expected Count	9,1	49,5	26,1	1,3	86,0
	% within Associated historic..	10,5%	57,0%	31,4%	1,2%	100,0%
1	Count	5	27	13	1	46
	Expected Count	4,9	26,5	13,9	,7	46,0
	% within Associated historic..	10,9%	58,7%	28,3%	2,2%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Associated historic..	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,319[a]	3	,956
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,70.

Short prose description * Knowledge level. Crosstab

Short prose description		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	8	51	33	2	94
	Expected Count	10,0	54,1	28,5	1,4	94,0
	% within Short prose description	8,5%	54,3%	35,1%	2,1%	100,0%
1	Count	6	25	7	0	38
	Expected Count	4,0	21,9	11,5	,6	38,0
	% within Short prose description	15,8%	65,8%	18,4%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Short prose description	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,272[a]	3	,153
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,58.

Long prose description * Knowledge level. Crosstab

Long prose description		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	7	38	11	1	57
	Expected Count	6,0	32,8	17,3	,9	57,0
	% within Long prose…	12,3%	66,7%	19,3%	1,8%	100,0%
1	Count	7	38	29	1	75
	Expected Count	8,0	43,2	22,7	1,1	75,0
	% within Long prose…	9,3%	50,7%	38,7%	1,3%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Long prose…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,752[a]	3	,124
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,86.

Country of production * Knowledge level. Crosstab

Country of production		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	8	37	19	0	64
	Expected Count	6,8	36,8	19,4	1,0	64,0
	% within Country of prod.	12,5%	57,8%	29,7%	,0%	100,0%
1	Count	6	39	21	2	68
	Expected Count	7,2	39,2	20,6	1,0	68,0
	% within Country of prod.	8,8%	57,4%	30,9%	2,9%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Country of prod.	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,319[a]	3	,509
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,97.

References to further info on the object * Knowledge level. Crosstab

References to further info on the object		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	7	37	15	0	59
	Expected Count	6,3	34,0	17,9	,9	59,0
	% within References to further info on the object	11,9%	62,7%	25,4%	,0%	100,0%
1	Count	7	39	25	2	73
	Expected Count	7,7	42,0	22,1	1,1	73,0
	% within References to further info on the object	9,6%	53,4%	34,2%	2,7%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within References to further info on the object	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,103[a]	3	,376
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,89.

Appendix 14: Test of associations between type of hobbyists *and* preferred data elements

Calculation of Chi-square test for associations between variables in questionnaire question number 10, “object related information”, and type of hobbyists.
The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle
In these cases there is a statistical significant association between the two variables being tested.
Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Physical description * Type of hobbyist. Crosstab

Physical description		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	28	18	46
	Expected Count	32,4	13,6	46,0
	% within Physical description	60,9%	39,1%	100,0%
1	Count	65	21	86
	Expected Count	60,6	25,4	86,0
	% within Physical description	75,6%	24,4%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Physical description	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,116[a]	1	,078
N of Valid Cases	132		

b. Computed only for a 2x2 table

Photo of object * Type of hobbyist. Crosstab

Photo of object		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	6	8	14
	Expected Count	9,9	4,1	14,0
	% within Photo of object	42,9%	57,1%	100,0%
1	Count	87	31	118
	Expected Count	83,1	34,9	118,0
	% within Photo of object	73,7%	26,3%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Photo of object	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,730[a]	1	,017
N of Valid Cases	132		

b. Computed only for a 2x2 table

Production year * Type of hobbyist. Crosstab

Production year		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	23	18	41
	Expected Count	28,9	12,1	41,0
	% within Production year	56,1%	43,9%	100,0%
1	Count	70	21	91
	Expected Count	64,1	26,9	91,0
	% within Production year	76,9%	23,1%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Production year	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,889[a]	1	,015
N of Valid Cases	132		

b. Computed only for a 2x2 table

Type of object * Type of hobbyist. Crosstab

Type of object		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	45	19	64
	Expected Count	45,1	18,9	64,0
	% within Type of object	70,3%	29,7%	100,0%
1	Count	48	20	68
	Expected Count	47,9	20,1	68,0
	% within Type of object	70,6%	29,4%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Type of object	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,001[a]	1	,972
N of Valid Cases	132		

b. Computed only for a 2x2 table

Who owned/used the object * Type of hobbyist. Crosstab

Who owned/used the object		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	45	22	67
	Expected Count	47,2	19,8	67,0
	% within Who owned/used the object	67,2%	32,8%	100,0%
1	Count	48	17	65
	Expected Count	45,8	19,2	65,0
	% within Who owned/used the object	73,8%	26,2%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Who owned/used the object	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,708[a]	1	,400
N of Valid Cases	132		

b. Computed only for a 2x2 table

When was the object used * Type of hobbyist. Crosstab

When was the object used		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	32	14	46
	Expected Count	32,4	13,6	46,0
	% within When was the object used	69,6%	30,4%	100,0%
1	Count	61	25	86
	Expected Count	60,6	25,4	86,0
	% within When was the object used	70,9%	29,1%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within When was the object used	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,027[a]	1	,870
N of Valid Cases	132		

b. Computed only for a 2x2 table

In which historic event was the object used * Type of hobbyist. Crosstab

In which historic event was the object used		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	46	16	62
	Expected Count	43,7	18,3	62,0
	% within In which historic event was the object used	74,2%	25,8%	100,0%
1	Count	47	23	70
	Expected Count	49,3	20,7	70,0
	% within In which historic event was the object used	67,1%	32,9%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within In which historic event was the object used	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,785[a]	1	,376
N of Valid Cases	132		

b. Computed only for a 2x2 table

In which countries was the object used * Type of hobbyist. Crosstab

In which countries was the object used		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	47	20	67
	Expected Count	47,2	19,8	67,0
	% within In which countries was the object used	70,1%	29,9%	100,0%
1	Count	46	19	65
	Expected Count	45,8	19,2	65,0
	% within In which countries was the object used	70,8%	29,2%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within In which countries was the object used	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,006[a]	1	,938
N of Valid Cases	132		

b. Computed only for a 2x2 table

Associated historic information on periods or events * Type of hobbyist. Crosstab

Associated historic info on periods or events		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	62	24	86
	Expected Count	60,6	25,4	86,0
	% within Associated historic info…	72,1%	27,9%	100,0%
1	Count	31	15	46
	Expected Count	32,4	13,6	46,0
	% within Associated historic info…	67,4%	32,6%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Associated historic info…	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,318[a]	1	,573
N of Valid Cases	132		

b. Computed only for a 2x2 table

Short prose description * Type of hobbyist. Crosstab

Short prose description		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	65	29	94
	Expected Count	66,2	27,8	94,0
	% within Short prose description	69,1%	30,9%	100,0%
1	Count	28	10	38
	Expected Count	26,8	11,2	38,0
	% within Short prose description	73,7%	26,3%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Short prose description	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,267[a]	1	,605
N of Valid Cases	132		

b. Computed only for a 2x2 table

Long prose description * Type of hobbyist. Crosstab

Long prose description		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	37	20	57
	Expected Count	40,2	16,8	57,0
	% within Long prose description	64,9%	35,1%	100,0%
1	Count	56	19	75
	Expected Count	52,8	22,2	75,0
	% within Long prose description	74,7%	25,3%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Long prose description	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,480[a]	1	,224
N of Valid Cases	132		

b. Computed only for a 2x2 table

Country of production * Type of hobbyist. Crosstab

Country of production		Type of hobbyist: Collectors	Lib.art enthusiast	Total
0	Count	41	23	64
	Expected Count	45,1	18,9	64,0
	% within Country of production	64,1%	35,9%	100,0%
1	Count	52	16	68
	Expected Count	47,9	20,1	68,0
	% within Country of production	76,5%	23,5%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Country of production	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,439[a]	1	,118
N of Valid Cases	132		

b. Computed only for a 2x2 table

References to further info on the object * Type of hobbyist. Crosstab

References to further info on the object		Type of hobbyist: Collectors	Lib.art enthusiast	Total
0	Count	36	23	59
	Expected Count	41,6	17,4	59,0
	% within References to further info…	61,0%	39,0%	100,0%
1	Count	57	16	73
	Expected Count	51,4	21,6	73,0
	% within References to further info…	78,1%	21,9%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within References to further info…	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,565[a]	1	,033
N of Valid Cases	132		

b. Computed only for a 2x2 table

Appendix 15: Test of associations between respondents' age *and* variables related to information sources

Calculation of Chi-square test for associations between variables in questionnaire question number 6, “information sources”, and “age”.

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Family and friends * Age. Crosstab

Family and friends		Age		
		Younger	Older	Total
0	Count	54	58	112
	Expected Count	58,5	53,5	112,0
	% within Family and friends	48,2%	51,8%	100,0%
1	Count	15	5	20
	Expected Count	10,5	9,5	20,0
	% within Family and friends	75,0%	25,0%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Family and friends	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,880[a]	1	,027
N of Valid Cases	132		

b. Computed only for a 2x2 table

Others with the same hobby * Age. Crosstab

Others with the same hobby		Age		
		Younger	Older	Total
0	Count	13	19	32
	Expected Count	16,7	15,3	32,0
	% within Others with the same hobby	40,6%	59,4%	100,0%
1	Count	56	44	100
	Expected Count	52,3	47,7	100,0
	% within Others with the same hobby	56,0%	44,0%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Others with the same hobby	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,297[a]	1	,152
N of Valid Cases	132		

b. Computed only for a 2x2 table

Public library * Age. Crosstab

Public library		Age		
		Younger	Older	Total
0	Count	48	50	98
	Expected Count	51,2	46,8	98,0
	% within Public library	49,0%	51,0%	100,0%
1	Count	21	13	34
	Expected Count	17,8	16,2	34,0
	% within Public library	61,8%	38,2%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Public library	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,654[a]	1	,198
N of Valid Cases	132		

b. Computed only for a 2x2 table

Special or research libraries * Age. Crosstab

Special or research libraries		Age		
		Younger	Older	Total
0	Count	49	36	85
	Expected Count	44,4	40,6	85,0
	% within Special or research libraries	57,6%	42,4%	100,0%
1	Count	20	27	47
	Expected Count	24,6	22,4	47,0
	% within Special or research libraries	42,6%	57,4%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Special or research libraries	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,764[a]	1	,096
N of Valid Cases	132		

b. Computed only for a 2x2 table

Archives * Age. Crosstab

Archives		Age		
		Younger	Older	Total
0	Count	54	46	100
	Expected Count	52,3	47,7	100,0
	% within Archives	54,0%	46,0%	100,0%
1	Count	15	17	32
	Expected Count	16,7	15,3	32,0
	% within Archives	46,9%	53,1%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Archives	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,493[a]	1	,482
N of Valid Cases	132		

b. Computed only for a 2x2 table

Own book collection * Age. Crosstab

Own book collection		Age		
		Younger	Older	Total
0	Count	36	25	61
	Expected Count	31,9	29,1	61,0
	% within Own book collection	59,0%	41,0%	100,0%
1	Count	33	38	71
	Expected Count	37,1	33,9	71,0
	% within Own book collection	46,5%	53,5%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Own book collection	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,067[a]	1	,150
N of Valid Cases	132		

b. Computed only for a 2x2 table

Documentary programs on TV/DVD * Age. Crosstab

Documentary programs on TV/DVD		Age		
		Younger	Older	Total
0	Count	47	48	95
	Expected Count	49,7	45,3	95,0
	% within Documentary programs…	49,5%	50,5%	100,0%
1	Count	22	15	37
	Expected Count	19,3	17,7	37,0
	% within Documentary programs…	59,5%	40,5%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Documentary programs…	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,064[a]	1	,302
N of Valid Cases	132		

b. Computed only for a 2x2 table

Discussion groups or mailing lists * Age. Crosstab

Discussion groups or mailing lists		Age		
		Younger	Older	Total
0	Count	35	44	79
	Expected Count	41,3	37,7	79,0
	% within Discussion groups or mailing lists	44,3%	55,7%	100,0%
1	Count	34	19	53
	Expected Count	27,7	25,3	53,0
	% within Discussion groups or mailing lists	64,2%	35,8%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Discussion groups or mailing lists	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,008[a]	1	,025
N of Valid Cases	132		

b. Computed only for a 2x2 table

Blogs * Age. Crosstab

Blogs		Age		
		Younger	Older	Total
0	Count	57	62	119
	Expected Count	62,2	56,8	119,0
	% within Blogs	47,9%	52,1%	100,0%
1	Count	12	1	13
	Expected Count	6,8	6,2	13,0
	% within Blogs	92,3%	7,7%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within Blogs	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9,264[a]	1	,002
N of Valid Cases	132		

b. Computed only for a 2x2 table

The Internet in general * Age. Crosstab

The Internet in general		Age		
		Younger	Older	Total
0	Count	18	25	43
	Expected Count	22,5	20,5	43,0
	% within The Internet in general	41,9%	58,1%	100,0%
1	Count	51	38	89
	Expected Count	46,5	42,5	89,0
	% within The Internet in general	57,3%	42,7%	100,0%
Total	Count	69	63	132
	Expected Count	69,0	63,0	132,0
	% within The Internet in general	52,3%	47,7%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,771[a]	1	,096
N of Valid Cases	132		

b. Computed only for a 2x2 table

Appendix 16: Test of associations between respondents' knowledge level *and* variables related to information sources

Calculation of Chi-square test for associations between variables in questionnaire question number 6, "information sources", and question number 7, "knowledge level".
The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle
In these cases there is a statistical significant association between the two variables being tested.
Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Family and friends * Knowledge level. Crosstab

Family and friends		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	13	62	36	1	112
	Expected Count	11,9	64,5	33,9	1,7	112,0
	% within Family and friends	11,6%	55,4%	32,1%	,9%	100,0%
1	Count	1	14	4	1	20
	Expected Count	2,1	11,5	6,1	,3	20,0
	% within Family and friends	5,0%	70,0%	20,0%	5,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Family and friends	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,045[a]	3	,257
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,30.

Others with the same hobby * Knowledge level. Crosstab

Others with the same hobby		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	5	17	10	0	32
	Expected Count	3,4	18,4	9,7	,5	32,0
	% within Others with the same hobby	15,6%	53,1%	31,2%	,0%	100,0%
1	Count	9	59	30	2	100
	Expected Count	10,6	57,6	30,3	1,5	100,0
	% within Others with the same hobby	9,0%	59,0%	30,0%	2,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Others with the same hobby	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,801[a]	3	,615
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,48.

Public library * Knowledge level. Crosstab

Public library		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	12	54	31	1	98
	Expected Count	10,4	56,4	29,7	1,5	98,0
	% within Public library	12,2%	55,1%	31,6%	1,0%	100,0%
1	Count	2	22	9	1	34
	Expected Count	3,6	19,6	10,3	,5	34,0
	% within Public library	5,9%	64,7%	26,5%	2,9%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Public library	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,204[a]	3	,531
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,52.

Special or research libraries * Knowledge level. Crosstab

Special or research libraries		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	14	53	16	2	85
	Expected Count	9,0	48,9	25,8	1,3	85,0
	% within Special or…	16,5%	62,4%	18,8%	2,4%	100,0%
1	Count	0	23	24	0	47
	Expected Count	5,0	27,1	14,2	,7	47,0
	% within Special or…	,0%	48,9%	51,1%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Special or…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20,175[a]	3	,000
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,71.

Archives * Knowledge level. Crosstab

Archives		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	14	60	24	2	100
	Expected Count	10,6	57,6	30,3	1,5	100,0
	% within Archives	14,0%	60,0%	24,0%	2,0%	100,0%
1	Count	0	16	16	0	32
	Expected Count	3,4	18,4	9,7	,5	32,0
	% within Archives	,0%	50,0%	50,0%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Archives	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10,949[a]	3	,012
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,48.

Own book collection * Knowledge level. Crosstab

Own book collection		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	11	42	7	1	61
	Expected Count	6,5	35,1	18,5	,9	61,0
	% within Own book collection	18,0%	68,9%	11,5%	1,6%	100,0%
1	Count	3	34	33	1	71
	Expected Count	7,5	40,9	21,5	1,1	71,0
	% within Own book collection	4,2%	47,9%	46,5%	1,4%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Own book collection	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21,680[a]	3	,000
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,92.

Documentary programs on TV/DVD * Knowledge level. Crosstab

Documentary programs on TV/DVD		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	11	55	28	1	95
	Expected Count	10,1	54,7	28,8	1,4	95,0
	% within Documentary…	11,6%	57,9%	29,5%	1,1%	100,0%
1	Count	3	21	12	1	37
	Expected Count	3,9	21,3	11,2	,6	37,0
	% within Documentary…	8,1%	56,8%	32,4%	2,7%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Documentary…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,864[a]	3	,834
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,56.

Discussion groups or mailing lists * Knowledge level. Crosstab

Discussion groups or mailing lists		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	10	46	21	2	79
	Expected Count	8,4	45,5	23,9	1,2	79,0
	% within Discussion groups	12,7%	58,2%	26,6%	2,5%	100,0%
1	Count	4	30	19	0	53
	Expected Count	5,6	30,5	16,1	,8	53,0
	% within Discussion groups	7,5%	56,6%	35,8%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Discussion groups	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,036[a]	3	,386
N of Valid Cases	132		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is ,80.

Blogs * Knowledge level. Crosstab

Blogs		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	13	68	36	2	119
	Expected Count	12,6	68,5	36,1	1,8	119,0
	% within Blogs	10,9%	57,1%	30,3%	1,7%	100,0%
1	Count	1	8	4	0	13
	Expected Count	1,4	7,5	3,9	,2	13,0
	% within Blogs	7,7%	61,5%	30,8%	,0%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within Blogs	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,374[a]	3	,946
N of Valid Cases	132		

a. 4 cells (50,0%) have expected count less than 5. The minimum expected count is ,20.

The Internet in general * Knowledge level. Crosstab

The Internet in general		Knowledge level				
		Novice	Some experience	Highly experienced	I don't know	Total
0	Count	2	22	19	0	43
	Expected Count	4,6	24,8	13,0	,7	43,0
	% within The Internet…	4,7%	51,2%	44,2%	,0%	100,0%
1	Count	12	54	21	2	89
	Expected Count	9,4	51,2	27,0	1,3	89,0
	% within The Internet…	13,5%	60,7%	23,6%	2,2%	100,0%
Total	Count	14	76	40	2	132
	Expected Count	14,0	76,0	40,0	2,0	132,0
	% within The Internet…	10,6%	57,6%	30,3%	1,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7,610[a]	3	,055
N of Valid Cases	132		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,65.

Appendix 17: Test of associations between type of hobbyists *and* variables related to information sources

Calculation of Chi-square test for associations between variables in questionnaire question number 6, “information sources”, and “type of hobbyists”.

The significance level α is set to 0.05. Cases where the obtained p-value is equal to or less than the pre-set significance level are marked with a circle

In these cases there is a statistical significant association between the two variables being tested.

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Family and friends * Type of hobbyist. Crosstab

Family and friends		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	78	34	112
	Expected Count	78,9	33,1	112,0
	% within Family and friends	69,6%	30,4%	100,0%
1	Count	15	5	20
	Expected Count	14,1	5,9	20,0
	% within Family and friends	75,0%	25,0%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Family and friends	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,234[a]	1	,629
N of Valid Cases	132		

b. Computed only for a 2x2 table

Others with the same hobby * Type of hobbyist. Crosstab

Others with the same hobby		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	19	13	32
	Expected Count	22,5	9,5	32,0
	% within Others with the same hobby	59,4%	40,6%	100,0%
1	Count	74	26	100
	Expected Count	70,5	29,5	100,0
	% within Others with the same hobby	74,0%	26,0%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Others with the same hobby	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,491[a]	1	,115
N of Valid Cases	132		

b. Computed only for a 2x2 table

Public library * Type of hobbyist. Crosstab

Public library		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	70	28	98
	Expected Count	69,0	29,0	98,0
	% within Public library	71,4%	28,6%	100,0%
1	Count	23	11	34
	Expected Count	24,0	10,0	34,0
	% within Public library	67,6%	32,4%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Public library	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,173[a]	1	,677
N of Valid Cases	132		

b. Computed only for a 2x2 table

Special or research libraries * Type of hobbyist. Crosstab

Special or research libraries		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	59	26	85
	Expected Count	59,9	25,1	85,0
	% within Special or research libraries	69,4%	30,6%	100,0%
1	Count	34	13	47
	Expected Count	33,1	13,9	47,0
	% within Special or research libraries	72,3%	27,7%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Special or research libraries	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,125[a]	1	,724
N of Valid Cases	132		

b. Computed only for a 2x2 table

Archives * Type of hobbyist. Crosstab

Archives		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	70	30	100
	Expected Count	70,5	29,5	100,0
	% within Archives	70,0%	30,0%	100,0%
1	Count	23	9	32
	Expected Count	22,5	9,5	32,0
	% within Archives	71,9%	28,1%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Archives	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,041[a]	1	,840
N of Valid Cases	132		

b. Computed only for a 2x2 table

Own book collection * Type of hobbyist. Crosstab

Own book collection		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	40	21	61
	Expected Count	43,0	18,0	61,0
	% within Own book collection	65,6%	34,4%	100,0%
1	Count	53	18	71
	Expected Count	50,0	21,0	71,0
	% within Own book collection	74,6%	25,4%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Own book collection	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,298[a]	1	,255
N of Valid Cases	132		

b. Computed only for a 2x2 table

Documentary programs on TV/DVD * Type of hobbyist. Crosstab

Documentary programs on TV/DVD		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	69	26	95
	Expected Count	66,9	28,1	95,0
	% within Documentary programs on TV/DVD	72,6%	27,4%	100,0%
1	Count	24	13	37
	Expected Count	26,1	10,9	37,0
	% within Documentary programs on TV/DVD	64,9%	35,1%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Documentary programs on TV/DVD	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,772[a]	1	,380
N of Valid Cases	132		

b. Computed only for a 2x2 table

Discussion groups or mailing lists * Type of hobbyist. Crosstab

Discussion groups or mailing lists		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	55	24	79
	Expected Count	55,7	23,3	79,0
	% within Discussion groups or mailing lists	69,6%	30,4%	100,0%
1	Count	38	15	53
	Expected Count	37,3	15,7	53,0
	% within Discussion groups or mailing lists	71,7%	28,3%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Discussion groups or mailing lists	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,066[a]	1	,798
N of Valid Cases	132		

b. Computed only for a 2x2 table

Blogs * Type of hobbyist. Crosstab

Blogs		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	89	30	119
	Expected Count	83,8	35,2	119,0
	% within Blogs	74,8%	25,2%	100,0%
1	Count	4	9	13
	Expected Count	9,2	3,8	13,0
	% within Blogs	30,8%	69,2%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within Blogs	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10,910[a]	1	,001
N of Valid Cases	132		

b. Computed only for a 2x2 table

The Internet in general * Type of hobbyist. Crosstab

The Internet in general		Type of hobbyist		
		Collectors	Lib.art enthusiast	Total
0	Count	27	16	43
	Expected Count	30,3	12,7	43,0
	% within The Internet in general	62,8%	37,2%	100,0%
1	Count	66	23	89
	Expected Count	62,7	26,3	89,0
	% within The Internet in general	74,2%	25,8%	100,0%
Total	Count	93	39	132
	Expected Count	93,0	39,0	132,0
	% within The Internet in general	70,5%	29,5%	100,0%

0 = variable not ticked off. 1 = variable ticked of

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,799[a]	1	,180
N of Valid Cases	132		

b. Computed only for a 2x2 table

Appendix 18: Test of associations between search tasks and search attributes

Calculation of ANOVA test for associations between the four search tasks (A, B, C and D) *and* seven search attributes.

The ANOVA test was carried out according to the following overall hypotheses:

H*o*: no difference exists between the different types of search tasks

H*a*: difference exists between the different types of search tasks

The significance level α is set to 0.05. If the obtained p-value is equal to or less than the pre-set significance level the null-hypothesis is rejected, and it is concluded that there is a statistical significant association between the variables being tested. These cases are marked with a circle in the appendix

Cases with a statistical weaker association between two variables (a p-value between 0.05 and 0.15) are marked with a dotted circle

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Search time (sec.)	Task A	24	297,71	136,263	27,815	240,17	355,25	90	645
	Task B	24	306,79	114,051	23,281	258,63	354,95	139	543
	Task C	24	450,17	383,551	78,292	288,21	612,13	84	1698
	Task D	24	331,08	191,373	39,064	250,27	411,89	61	825
	Total	96	346,44	236,437	24,131	298,53	394,34	61	1698
Number of viewed hits	Task A	24	29,71	7,238	1,477	26,65	32,76	16	47
	Task B	24	10,29	5,989	1,222	7,76	12,82	7	29
	Task C	24	28,88	18,704	3,818	20,98	36,77	10	76
	Task D	24	29,54	27,855	5,686	17,78	41,30	6	141
	Total	96	24,60	19,053	1,945	20,74	28,46	6	141
Number of records viewed	Task A	24	2,04	1,546	,316	1,39	2,69	0	5
	Task B	24	3,58	3,256	,665	2,21	4,96	0	15
	Task C	24	2,88	4,276	,873	1,07	4,68	0	16
	Task D	24	2,33	1,971	,402	1,50	3,17	0	7
	Total	96	2,71	2,977	,304	2,11	3,31	0	16
Number of photos viewed	Task A	24	,71	,999	,204	,29	1,13	0	3
	Task B	24	,38	,770	,157	,05	,70	0	3
	Task C	24	1,25	3,011	,615	-,02	2,52	0	15
	Task D	24	,83	1,007	,206	,41	1,26	0	3
	Total	96	,79	1,710	,175	,45	1,14	0	15
Number of times zoom function used	Task A	24	,42	,654	,133	,14	,69	0	2
	Task B	24	,17	,637	,130	-,10	,44	0	3
	Task C	24	,54	1,141	,233	,06	1,02	0	5
	Task D	24	,25	,737	,150	-,06	,56	0	3
	Total	96	,34	,819	,084	,18	,51	0	5
Number of registration material viewed	Task A	24	,79	1,103	,225	,33	1,26	0	3
	Task B	24	2,21	2,553	,521	1,13	3,29	0	11
	Task C	24	1,75	2,418	,494	,73	2,77	0	10
	Task D	24	1,62	1,765	,360	,88	2,37	0	5
	Total	96	1,59	2,075	,212	1,17	2,01	0	11
Number of search iterations	Task A	24	1,42	1,530	,312	,77	2,06	0	5
	Task B	24	1,38	1,583	,323	,71	2,04	0	5
	Task C	24	,58	1,717	,351	-,14	1,31	0	8
	Task D	24	,79	1,062	,217	,34	1,24	0	3
	Total	96	1,04	1,514	,155	,73	1,35	0	8

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Search time (sec.)	Between Groups	358603,542	3	119534,514	2,221	,091
	Within Groups	4952128,083	92	53827,479		
	Total	5310731,625	95			
Number of viewed hits	Between Groups	6564,458	3	2188,153	7,210	,000
	Within Groups	27922,500	92	303,505		
	Total	34486,958	95			
Number of records viewed	Between Groups	33,083	3	11,028	1,254	,295
	Within Groups	808,750	92	8,791		
	Total	841,833	95			
Number of photos viewed	Between Groups	9,417	3	3,139	1,076	,363
	Within Groups	268,417	92	2,918		
	Total	277,833	95			
Number of times zoom function used	Between Groups	2,031	3	,677	1,011	,392
	Within Groups	61,625	92	,670		
	Total	63,656	95			
Number of registration material viwed	Between Groups	25,115	3	8,372	2,005	,119
	Within Groups	384,042	92	4,174		
	Total	409,156	95			
Number of search iterations	Between Groups	12,583	3	4,194	1,880	,138
	Within Groups	205,250	92	2,231		
	Total	217,833	95			

Post Hoc Tests

Multiple Comparisons

LSD

Dependent Variable	(I) Task	(J) Task	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Search time (sec.)	Task A	Task B	-9,083	66,975	,892	-142,10	123,93
		Task C	-152,458*	66,975	,025	-285,48	-19,44
		Task D	-33,375	66,975	,619	-166,39	99,64
	Task B	Task A	9,083	66,975	,892	-123,93	142,10
		Task C	-143,375*	66,975	,035	-276,39	-10,36
		Task D	-24,292	66,975	,718	-157,31	108,73
	Task C	Task A	152,458*	66,975	,025	19,44	285,48
		Task B	143,375*	66,975	,035	10,36	276,39
		Task D	119,083	66,975	,079	-13,93	252,10
	Task D	Task A	33,375	66,975	,619	-99,64	166,39
		Task B	24,292	66,975	,718	-108,73	157,31
		Task C	-119,083	66,975	,079	-252,10	13,93
Number of viewed hits	Task A	Task B	19,417*	5,029	,000	9,43	29,40
		Task C	,833	5,029	,869	-9,15	10,82
		Task D	,167	5,029	,974	-9,82	10,15
	Task B	Task A	-19,417*	5,029	,000	-29,40	-9,43
		Task C	-18,583*	5,029	,000	-28,57	-8,60
		Task D	-19,250*	5,029	,000	-29,24	-9,26
	Task C	Task A	-,833	5,029	,869	-10,82	9,15
		Task B	18,583*	5,029	,000	8,60	28,57
		Task D	-,667	5,029	,895	-10,65	9,32
	Task D	Task A	-,167	5,029	,974	-10,15	9,82
		Task B	19,250*	5,029	,000	9,26	29,24
		Task C	,667	5,029	,895	-9,32	10,65
Number of records viewed	Task A	Task B	-1,542	,856	,075	-3,24	,16
		Task C	-,833	,856	,333	-2,53	,87
		Task D	-,292	,856	,734	-1,99	1,41
	Task B	Task A	1,542	,856	,075	-,16	3,24
		Task C	,708	,856	,410	-,99	2,41
		Task D	1,250	,856	,148	-,45	2,95
	Task C	Task A	,833	,856	,333	-,87	2,53
		Task B	-,708	,856	,410	-2,41	,99
		Task D	,542	,856	,528	-1,16	2,24
	Task D	Task A	,292	,856	,734	-1,41	1,99
		Task B	-1,250	,856	,148	-2,95	,45
		Task C	-,542	,856	,528	-2,24	1,16

Number of photos viewed	Task A	Task B	,333	,493	,501	-,65	1,31
		Task C	-,542	,493	,275	-1,52	,44
		Task D	-,125	,493	,800	-1,10	,85
	Task B	Task A	-,333	,493	,501	-1,31	,65
		Task C	-,875	,493	,079	-1,85	,10
		Task D	-,458	,493	,355	-1,44	,52
	Task C	Task A	,542	,493	,275	-,44	1,52
		Task B	,875	,493	,079	-,10	1,85
		Task D	,417	,493	,400	-,56	1,40
	Task D	Task A	,125	,493	,800	-,85	1,10
		Task B	,458	,493	,355	-,52	1,44
		Task C	-,417	,493	,400	-1,40	,56
Number of times zoom function used	Task A	Task B	,250	,236	,293	-,22	,72
		Task C	-,125	,236	,598	-,59	,34
		Task D	,167	,236	,482	-,30	,64
	Task B	Task A	-,250	,236	,293	-,72	,22
		Task C	-,375	,236	,116	-,84	,09
		Task D	-,083	,236	,725	-,55	,39
	Task C	Task A	,125	,236	,598	-,34	,59
		Task B	,375	,236	,116	-,09	,84
		Task D	,292	,236	,220	-,18	,76
	Task D	Task A	-,167	,236	,482	-,64	,30
		Task B	,083	,236	,725	-,39	,55
		Task C	-,292	,236	,220	-,76	,18
Number of registration material viewed	Task A	Task B	-1,417*	,590	,018	-2,59	-,25
		Task C	-,958	,590	,108	-2,13	,21
		Task D	-,833	,590	,161	-2,00	,34
	Task B	Task A	1,417*	,590	,018	,25	2,59
		Task C	,458	,590	,439	-,71	1,63
		Task D	,583	,590	,325	-,59	1,75
	Task C	Task A	,958	,590	,108	-,21	2,13
		Task B	-,458	,590	,439	-1,63	,71
		Task D	,125	,590	,833	-1,05	1,30
	Task D	Task A	,833	,590	,161	-,34	2,00
		Task B	-,583	,590	,325	-1,75	,59
		Task C	-,125	,590	,833	-1,30	1,05
Number of search iterations	Task A	Task B	,042	,431	,923	-,81	,90
		Task C	,833	,431	,056	-,02	1,69
		Task D	,625	,431	,151	-,23	1,48
	Task B	Task A	-,042	,431	,923	-,90	,81
		Task C	,792	,431	,070	-,06	1,65
		Task D	,583	,431	,179	-,27	1,44
	Task C	Task A	-,833	,431	,056	-1,69	,02

		Task B	-,792	,431	,070	-1,65	,06
		Task D	-,208	,431	,630	-1,06	,65
	Task D	Task A	-,625	,431	,151	-1,48	,23
		Task B	-,583	,431	,179	-1,44	,27
		Task C	,208	,431	,630	-,65	1,06

*. The mean difference is significant at the 0.05 level.