Isto Huvila

The Ecology of Information Work

A Case Study of Bridging Archaeological Work and Virtual Reality Based Knowledge Organisation

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It is impossible to determine precisely when the first steps of this research were taken. The moment might have been in April 2001 in Visby, Gotland. During a late evening after-hour of the Computer Applications and Quantitative Methods in Archaeology conference, Stephen Stead happened to mention that someone ought to look closer to the issues of how an archaeological virtual reality should be documented. After that first impulse, it took a couple of years to mature the idea, and to find out that exploring the question of documentation was actually only a small part of what might be done. During my journey to the world of archaeology, information work and virtual realities, I have received financial support, invaluable advice, help and encouragement from numerous persons and institutions to whom I am deeply grateful.

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Åbo, October 2006

Isto Huvila

Contents

IV Appendices

List of Tables

List of Figures

Chapter 1

Introduction

From time to time "when you are a Bear of Very Little Brain, and you Think of Things, you sometimes find that a Thing which seemed very Thingish inside you is quite different when it gets out into the open and has other people looking at it" [525][1]. There is a lot of information yet to come, but still quite often, a relevant piece of information is already out there. One problem is that the relevant information is often difficult to find. A real difficulty is, however, in finding out when a piece of information might become relevant for a particular purpose, or when a Thing is sufficiently Thingish for someone at the moment it comes into the open. The issue might be argued to be about contexts and how the information resides and appears within their limits. The Things are quite different depending on the order and place, in which they are being presented.

The issue of organising information in a functioning manner concerns equally the individuals, organisations and entire domains of knowledge. To be successful, an organisation needs to provide its members with precise information at the right moment to complete the right assignment. The problem is not to point out who is the available person, or what is the available information or what is the assignment. The problem is to make them all converge in a productive manner.

The present study is an investigation of work and information work, and how they might be managed by organising knowledge. The study is also about archaeology and archaeologists, although its implications do not necessarily confine themselves to any particular sector of work or information. The aim is to peruse the interface between human information work and such infrastructural systems, which are used to organise knowledge and information. The study presents an approach called information work analysis, to investigate human work and information work in context. The understanding, which is attained as a result of the information work analysis, is applied to an explication of the potential convergences

[1]For the references, the current study uses an adapted version of the Vancouver style system used in the Association for Computing Machinery (ACM) publications. Within the text, the literature is cited as numerical references, which are given in square brackets. The numbers refer to the corresponding references in the combined bibliography and a list of references, which is organised alphabetically (cf. the Vancouver system). The subsequent numbers or keywords located in the brackets and separated by a comma from the number of the reference, refer to the pages or sections cited within the reference.

In-text citations are marked with double quotation marks. Whenever the case or formatting of the citation is altered for correct spelling or emphatical purposes, the part of the text is inserted in square brackets.

References cited in brackets and marked with abbreviation "ref." are used to indicate references to additional and comparative material and background to the matter, which is under scrutiny.

between information work practises and the characteristics of knowledge infrastructures.

The discussion refers to the notion of virtual realities and explores their eventual role as knowledge infrastructures using the domain of archaeology as an example. Why then virtual reality? The entire concept is largely ambiguous, yet still loaded with expectations, enthusiasm and grand promises. Virtual realities have become a popular 'Thing' in many sectors from medicine to industrial design. The promise of being able to simulate and recreate has been especially attractive to archaeologists, who have been troubled with the difficulty of seeing into the past and visualising it as it might have been. The popularity of the debate becomes apparent by watching the recent TV documentaries such as "Pompeii: The Last Day" (BBC) or browsing the proceedings of the archaeological computing and informatics conferences such as the CAA (Computer Applications and Quantitative Methods in Archaeology) and VAST (International Symposium on Virtual Reality, Archaeology and Cultural Heritage) for the last decade. The introduction of virtual realities is an opportunity and a challenge for communicating the past, but it also presents a new challenge of managing the increasing amount of information made available in the virtual reality realisations. Virtual realities certainly look impressive. The question is, however, to whom, for what purposes and on what premises they might be *useful*. The present study suggests that the task of finding an answer to the last question is an issue of understanding how the workers, instruments, the necessary information, the virtual realities and the work relate to each other.

1.1 Purpose of the research

The fundamental purpose of the current study is to examine the organisation of information work and its expressions in the human work processes. In the first place **1) the study aims at developing a working approach and subsequently an understanding of the implicit information related issues of practical work and a method to describe them in an explicit manner.** The second important purpose is to discuss **2) how to operationalise the acquired understanding of the information work so that it may be used in the processes of designing, constructing and using information and knowledge organisation systems.** Both purposes indicate a task of establishing premises for bridging the notions 'information work' and 'virtual reality as a knowledge organisation system'. The implication of this enhanced understanding is to contribute to the task of making a usable piece of information to reach the right person at the right moment.

The perspective of the present investigation combines a systemic, i.e. systems theory based, approach to the management of the life-cycle of information, and the viewpoint of considering virtual reality as an instrument of organising knowledge. *Human-beings, information*, *information work* and *information systems* are seen as components of an inclusive system of human work, which has a distinct set of characteristics and qualities. To manage and empower the work, it is necessary to understand the associated people, machines, information, interactions and behaviours, and the broad notions of work related purposes, meanings and values. *Virtual reality* is discussed in two meanings. It is a conceptual tool for understanding the information and work processes. It is also seen as a practical instrument for coping with the infrastructures of archaeological work, and a basis for developing new information systems, knowledge organisation and management practises to support information work throughout the extended life-cycle of information.

The research is conducted by examining the issues of information work and virtual realities through a case example of archaeological information. The particular interest of the case study is in the scholarly and professional uses of information. The empirical study consists of altogether 25, on average 150 minute long, thematic interviews with archaeology professionals from Finland and Sweden. The focus of the analysis is on the archaeologists and how they themselves perceive their own work, its practises, purposes, meanings and values.

The first context of the relevance of studying archaeologists and their information work is that the import of the archaeological work has become increasingly evident in contemporary society. The societal and economic value of cultural heritage has attracted increasing attention in scholarly and public debate [247][285] around the world. Archaeology costs, but it also produces revenues in both economic and societal terms. Besides the cultural considerations, archaeology and especially the concept of 'heritage' have become notions of political and economic concern [696][147].[2] The importance of conducting adequate investigations on the sites of the future private and community land use has been recognised. The technical and methodological developments have increased the possibilities of extracting more information from the archaeological sites and materials. Archaeology is increasingly challenged by demands for a more thorough and yet more rapid and efficient investigation process, and by the colossal issue of the need to manage the fast accumulating amounts of archaeological information [507][793].

Archaeology, history and cultural heritage have become assets [535] (ref. also [507]), which require explicit management. As the DigiCULT report (commissioned by the European Commission DG for Information Society) suggested in the beginning of 2002, the visions have indeed evolved from the 1996 idea of a "rosy future" through a "dreary" phase to a future with "some sunshine" on the horizon [247, 25]. The promises of the cultural heritage management and cultural heritage information management advocates need to be considered critically, but basically the management approach shows promise in providing a set of effective means to deal with the heritage assets, even if no impending miracle cure or soft options seem to be in the immediate future.

Besides the explicit relevance of studying archaeological work, another motivation for referring to archaeology as a case example, relates to the broader goals of the study to enhance the understanding of the interplay between information, work and knowledge organisation infrastructures. The general contributions of this study are not confined to any individual sector of information or work. **The second context of relevance for the present study is that understanding archaeology helps understanding other contexts of information work far beyond the scope of 'the cultural heritage', 'the past' and 'the material remains'.** This study addresses the overall issue of managing knowledge formation, communication and information processes in the context of contemporary society. In this ample understanding of the context of the present research effort, the discipline of archaeology is considered to be an illustrative case example of the complexities of information work. It is illustrative of the cultural heritage information work, but also of the information work understood in more broader terms. The variety of materials and diversity of uses, which is related to the archaeological practise, data, information and knowledge, make archaeology essentially 'difficult'. Archaeology involves phys-

[2] The present study concentrates on the precise domain of archaeology, but perceives it as inseparable from the concepts and the debate, which relate to 'heritage' and 'cultural heritage'. Archaeology is seen in this study as a discipline and profession, which is responsible for the archaeological section of the complete sphere of 'heritage' (ref. [39][696][147][389]).

ical entities and their interpretation. As a domain, it is broad and it has various interfaces with other scholarly fields. Besides the internal complexity, archaeology also embraces a multiplicity of practical and cultural implications on the level of the entire society. In the same manner as archaeology is paradigmatic of the diversity of information management related challenges, the virtual realities do represent an exemplary instrument for addressing the issues of organising, processing and managing information and knowledge.

The focus of this study is not in technologies and tools, but in identifying the critical factors which contribute to the success of work and information work (cf. [598]). Its aim in respect of archaeology and cultural heritage preservation, curation and information management, is to contribute to "a clearer understanding of the needs of diverse disciplines". This agenda was proposed in the report of the "Digital Curation and Preservation: Defining the research agenda for the next decade" workshop [310, 5 and 14] as an important step in the process of developing information work practises for the digital future. Besides being a crossdisciplinary effort itself, this study also aims to contribute to the explication of the essential archaeology related premises and priorities in the forthcoming crossdisciplinary work.

1.2 Research questions

The purpose of the present study is to examine the complexities of archaeological information work as an example of the possible intricacies of the information related interactions in different work contexts. Thus the overall research question is: **how the use of virtual reality environments could benefit the management of knowledge formation and communication processes?** The question is essentially a heuristic one and approaches the issue of developing and evolving future infrastructures by emphasising a thorough understanding of the existing information processes. The specific issues this study attempts to grasp are:

1. **How the systemic notion of information work functions as a conceptual tool for analysing and discussing work related information activities in context?** The question is essentially about understanding and describing information and work processes within a domain. It is about finding out indicative determinants and systemic components, and learning about the dynamics of information work. Finally, the question broadens to embrace a further question of the possibilities to make meta-domain level analytic remarks on information work in similar domains on the basis of the material covered in the present study.

2. **What are the critical issues, which affect the success, effectiveness and efficiency of information work in the domain of archaeology?** The study discusses the notions of success, effectiveness and efficiency in a broad economic, societal and cultural perspective. The question grasps the issue of whether the present paradigm of activity ('the ways of doing things') relates to the explicit and implicit objectives of the 'work'? The practical forms of information work may or may not address the matters declared to be important. Finding eventual gaps and weak links is important in order to be able to keep the focus of the process on providing meaningful solutions to the various issues, which araise within the domain. The question is about explicating whether, or how, the present patterns of information work compare with the explicit and im-

plicit ambitions and objectives of the domain, and how the information work might be developed to support these goal settings better.

3. **Can a virtual reality be used as a framework of knowledge organisation to manage information and information processes in order to to empower information work?** The research question is about mapping the infrastructures of information processes, their dimensions and characteristics into the domain of the virtual realities, and about whether the virtual realities permit representing the constituent infrastructural attributes of the information work.

4. **How would an eventual virtual reality based knowledge organisation map for the different aspects and types of information work?** What kinds of information interactions and behaviours the notion of virtual reality could potentially support, and what kind of information work is least fitted to be supported by the same notion?

1.3 Structure of the dissertation

The dissertation consists of three parts. The first part discusses the theoretical framework of the study. Chapter 2 describes the management oriented viewpoint on information work and information life-cycles, and describes a systemic understanding of the human information work assumed in the present study. Chapter 3 discusses the notions of knowledge organisation and the virtual realities (VR), and finally summarises the assumed viewpoint of virtual realities as systems of knowledge organisation.

The second part of the dissertation comprises an explication of the findings of the empirical study. Chapter 4 describes the research material and the methods of its gathering. Chapter 5 discusses the findings about how the informants perceived archaeology and the archaeological work. Chapter 6 explicates further the work of the informants in a form of an information work analysis. The analysis of the empirical material revealed seven archaeological work roles (field archaeology antiquarian, public dissemination, academic research, academic teaching, cultural heritage management and infrastructural development). Chapter 7 concentrates to discuss the dimensions of archaeological information work and information work process by explicating archaeologists' information source use, information behaviour, information horizons and information interactions, and the archaeological information process. The chapter is concluded by the rendering of two critical success factors of the archaeological information work: fit and sustainability. The last chapter of the second part of the study (8) draws together the attained understanding of the premises and requirements of the archaeological knowledge organisation, and subsequently explores their convergence with the notion of virtual realities.

The findings of the study are discussed in the last part of the dissertation in chapter 9, which ties together the empirical findings and the theoretical background of the study. Appendices consist of the letters of invitation and interview guide.

Part I

Theoretical framework

This study is based on two general notions. First, it is assumed that the role of information merits more comprehensive understanding and more effective management in different contexts of human work than that which has been achieved until now. The second notion is that a mature understanding presupposes a more thorough attention to the functioning of the organisational infrastructures of information. The present study sets out to explicate an ecological perspective (ref. Section 2.6.5) of the systems of work, information work and infrastructures with a special focus on the contingent possibilities of the notion of 'virtual realities'.

In spite of the rapid advances of virtual reality technologies, at the present it seems clear that 'ideal' infrastructures built on virtual reality based knowledge organisation do not exist as yet. It is necessary to study the existing virtual reality systems and to assess the results of the few evaluations made [599]. However, due to the 'in progress' -nature of the present systems, the evaluation approach needs to be complemented with a more contextually and situationally oriented investigation. Therefore, the practical approach assumed in the present study is to investigate the premises of such systems from user, usage, content and systems perspectives. Users[3] and use processes are examined from the information work and information behaviour points of view. After that the discovered information processes are situated in a context of usage (archaeology) modelled by using a domain analytical methodological frame of reference. The knowledge about the domain is analysed in a systems oriented perspective referring to the theoretical premises of the virtual realities and to relevant experiences of the present and past virtual reality experiments.

Within the frames of information science[4] the present study represents a 'soft' or human centred line of research, even though it draws considerably on the 'hard' tradition with an attempt to benefit from the both worlds. Saracevic considers that the conflict between the hard and soft approaches is somewhat artificial and wonders the rarity of contributions, which would attempt to reach a fruitful consensual position [660] (ref. also [69]). The conflict is striking especially, because in a practical information work, the perspectives are impossible to distinguish [660, 1058] (also [420]). Bridging, which brings the fields of systems centric information retrieval and human centric information seeking together, would eventually benefit both parties as suggested by Ingwersen and Järvelin [398]. The current study attempts to be such a contribution, although acknowledging that it is bound to be impossible to actually weld together the 'hard' and 'soft' in a definitive manner (ref. [557]). A desired state would undoubtedly be a "peaceful coexistence" [557] in the spirit of pragmatism, which would allow the emergence of the benefits of the both standpoints.

[3]The term 'user' refers to anyone who *interacts* with information or a system both in passive sense of using and in the active sense of contributing.

[4]The present work uses the term 'information science' to refer to the academic field also referred to as *information studies* and *library and information science* (LIS). 'Information sciences' is used to denote all explicitly information related scientific and scholarly disciplines including the information science, information systems science, computer science and related fields.

Chapter 2

Information work and life-cycle: a management perspective

The present study explores information and information related human activity. The scrutiny spans throughout the life-cycle of information from the emergence of information to its organisation and use. The basic assumption is that an information process may be managed either directly or indirectly in the different phases of its course. Management does not necessarily denote a total state of control, but a capability to steer, guide and anticipate synergies and dissonances in the interactions between humans and information.

The information is examined in contexts by using a life-cycle model as a conceptual framework. The life-cycles of information and human activity are discerned from a soft systems perspective as iterative and intertwined systems. The entirety of what human-beings do, is seen as a complex meta-system consisting of innumerable systems, which represent the gamut of individual and collective human pursuits. The life-cycle of information is tightly interfaced with the numerous systems of human activity and their contexts. Both the human systems and the systems of information, have their own ecologies, codes of how they behave, live, develop and change. The narrower system of information activity contributes explicitly and implicitly to the broader system of human activity. Both systems evolve due to the influence of their mutual interactions, which perpetually involve emergence, organisation, dissemination, use and preservation of information.

The following sections discuss the information viewpoint and the related concepts of information management, information process, information life-cycle and information work with their respective implications. Furthermore, the chapter discusses the concepts of work and work roles, and brings the information and work related notions together in an ecological, systemics oriented framework. In the final section of the chapter, the present approach is compared to a related framework denoted as cognitive work analysis.

2.1 Information management

Information management has been broadly defined as the structuring and processing of information in organisations with the goal of improving the premises of organisational performance. Information management is a practical perspective, which focusses on analysing existing information resources, methods, strategies and processes. The foundations of the standpoint reside in several disciplines including information science, business administration, information systems science, organisation studies and the management sciences.

The precise scope of information management[1] is under debate, yet inclusive notions tend to be prevalent. According to Wilson, the scope of information management excludes organisational management of information use, its creation, sharing and application in different contexts [841, 163]. Among others Choo [165, 164], Davenport and Prusak [215], Widén-Wulff [827] and Huotari [391] perceive information management as a notion, which grasps the entire chain of information production and use. The present study assumes the inclusive notion and discusses information management in the context of the entire life-cycle of information (ref. 2.3). It is argued that the narrower perspectives acontextualise information management to a mechanical processing of commodities. The inclusive notion is, on the other hand, more sensitive to the social and cultural embeddedness of human activity.

The relevance of the management perspective to the information in the context of the current study relates to the design and the practical objectives of the research (ref. Section 1.2). This study aims to contribute to the pragmatic understanding of the actual information work practises within the current domain of interest. Furthermore, the aim is to provide workable understanding for implementing beneficial changes in the premises of work and information work in the organisations. Thus the objective of this study is to provide relevant understanding for the purposes of changing and managing the domain instead of merely describing its present state.

2.2 Information process

A process based view of the information activities is typical in information science literature. The approach is referred to both in information behaviour studies and in information retrieval oriented research (e.g. [460][181][791]). A process refers to a series of information related interactions as a continuum, where the earlier phases and experiences affect the subsequent needs and decisions.

An information process is basically a human process, where the interactions involve various *information objects*. An information object is typically considered to be a consequence of another, earlier information process, e.g. information need, which triggers a process of e.g. writing a book or commissioning a database. The first process (information need) made the object necessary and subsequently rendered it available for the original person in need, but also for many others involved in further information processes.

[1] The interface between information management and knowledge management is rather indecisive. The first one has gained prevalence in information science, while knowledge management is preferred in, for instance, business and information technology contexts. Illustrative of the debate is that Bouthillier and Shearer argue that the two concepts are distinct [111], while Wilson denies the relevance of knowledge management altogether [841].

The present study understands the concept of *information process* fundamentally as an organised sequence of information interactions with a specific purpose, which may be either potential or actual, implicit or explicit, and related to the entire life-world or merely to the professional work of an individual. The interactions do not necessarily follow each other in a specific sequence such as need - production - acquiring - use. On one hand, the complexity, ambiguity, volatility and situatedness of the sequences and individual interactions tend to make the managing of the information processes difficult, but also necessary, in order to empower the work with information.

2.3 Information life-cycle

The life-cycle of information may be considered to be an extension of the process thinking. Eaton and Bowden stated in their perusal of the nature of information as a resource that information has a life-cycle beginning from the definition of needs and proceeding to the collection, transmission, processing, storage, dissemination, use, and finally disposal [246] (ref. Fig. 2.1). An advantage of the life-cycle approach is its explicit cognisance of time and duration.

Different authors have discussed information life-cycle models with a somewhat varying focus on the information processes and phases of a 'complete' life-cycle (e.g. [246][103][841]). Due to their general conceptual relevance, the life-cycles have been used with a reference to the viewpoints of management, preservation (e.g. [74][647]) and cost (e.g. in [733]). For instance, the LIFE project report on the life-cycle literature [813] reviews extensively approaches, which are relevant to costing.

Information related life-cycle models have attracted special attention in software engineering and information systems science within the scope of information systems development (e.g. [365]) and management [238]. Records management specialists have discussed the information life-cycle as the principal focus of their attention and conceptualised their entire field through the notion of managing the life-cycle of information [667][316][369]. Information life-cycle management is also seen as the focal point of information resources management [91] and long-term preservation [20]. In economics, the information life-cycle management (ILM) has been perceived as a strategic component of the economics of information [615].

In an attempt to present a broad general view of the information life-cycle, the UCLA based "Social aspects of Digital Libraries project" has compiled a general model of an information life-cycle (e.g. [104][286], see Fig. 2.1)[2].

Besides the complete notions of information life-cycle, the life-cycle approach has been applied to the specific phases of the chain of information. Levitan [486] discusses the life-cycle of information from the production and commodity point of view focussing on the emergence, growth and decline of 'useful information' [344]. Ohmukai et al. [563] present a top level life-cycle of information, which consists of three phases: collect, create and donate.

The notion of information life-cycle may be used to denote both intraorganisational [351] and general processes [104]. A usual conception suggests that information is created, disseminated, organised and utilised in a matrix, which consists of the entirety of the human societies. Books are written by authors at home,

[2] An essentially similar model has been referred by Wilson as an "extended life-cycle of information" in contrast to a life-cycle, which excludes the use and creation of information [841].

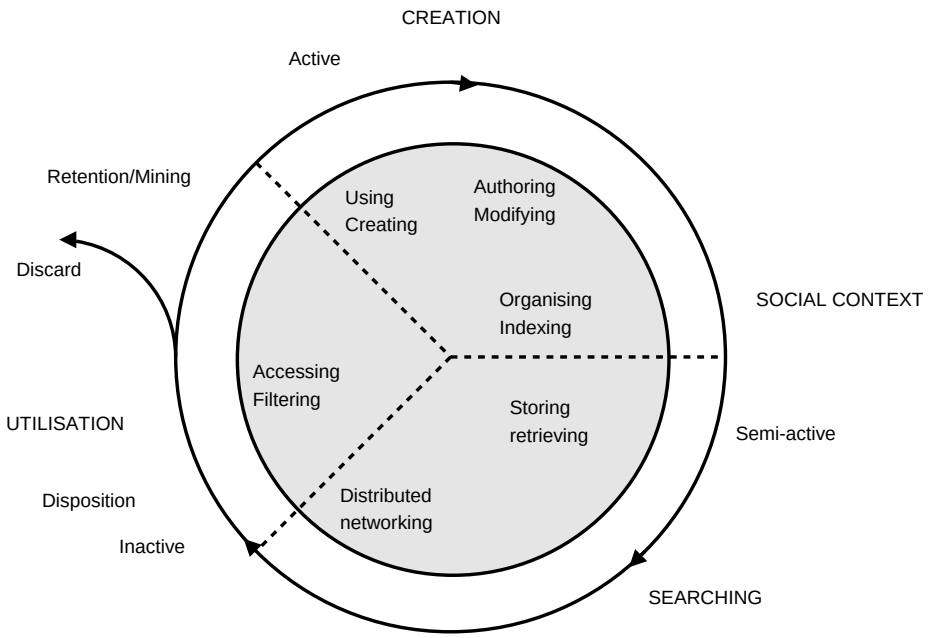


Figure 2.1: The UCLA information life-cycle model (from [104]). "The outer ring indicates the life cycle stages (active, semi-active, and inactive for a given type of artifact (such as business records, artworks, documents, or scientific data): The stages are superimposed on six types of information uses or processes (shaded circle). The cycle has three major phases: information creation, searching, and utilization. The alignment of the cycle stages with the steps of information handling and process phases may vary according to the particular social or institutional context" [104].

published by publishing houses, disseminated through bookshops, organised by libraries and utilised by library users.

The evolution of digital information, global networks and a worldwide connectivity have turned the emphasis to the bringing the entire process on personal desktops. The life-cycle may be intervened simultaneously by individuals in the different parts of the world and the process might be available within a single centralised or distributed framework designed both for the management and the use of information. The framework becomes in a sense, a digital age 'institution'.

In his exploration of the digital age information flows, Chen considers digital libraries *as* life-cycles of information [162, 18]. The focal point of the comprehensive digitally created and interactive information infrastructures referred to as digital libraries (or repositories), is their capability to encompass the entire life-cycle within their confines. Users and managers may create, organise, disseminate and use information concurrently in an arbitrary sequence within the repository using a single interface. The infrastructure embraces the complete information life-cycle. The result is a self-organising process as suggested by Chen [162, 18], which consists of the phases of (creation), dissemination, acquisition, collection, organisation, indexing, and utilisation.

2.4 Information as a viewpoint

The relevance of discussing the concept of information in depth, lies in the constituency of the related notions of information management, information life-cycle, information behaviour and information work. The present study uses these concepts as explanatory instruments for expounding human activity. Therefore the information is articulated to an explicit scholarly viewpoint with a special relevance to the studying of the social world.

There is an abundance of standpoints to take when it comes to the concept 'information' [484]. The choice should always be, however, a pragmatic one [146] to match the necessities of the information related research. The present study does not assume that a universal definition of information would necessarily exist (cf. [484]). The presumed point of view allows diverse descriptions and framings of information in various practical and scholarly contexts. Instead of attempting to be a general theory, it aims merely to grasp a functional approach (for actual debate on the subject, ref. [553]). As the current study is about information work and processes, which relate to the infrastructures of information, the focus of the attention is not the nature of the information itself. The interest lies in the mechanisms of how the information is coming to being, emerging and transforming, and in the implications of the different ways of understanding information to the key concepts of information management, information work, information life-cycle, and the 'knowledge organisation'.

The purpose of the following sections is to discuss the concepts of information and knowledge, and to describe the explicitly information oriented viewpoint followed by the current study.

2.4.1 Information

The notion of information is often used in everyday life contexts to denote both information and something someone knows. Information systems are built, information is organised and managed to let us know better. The talks about information

society and information highways all conceal a hidden notion of increased state of knowing. This colloquial view is a somewhat empty standpoint from an analytical point of view, but bears some definite meaning concerning the pragmatic prospects of information work. The term information is often used when people are willing to know more even though the precise meaning of 'information' is routinely left equivocal [713].

Within the scope of the present study, information is first and foremost perceived as a practical matter with which people are working. Information is a means to perform practical tasks and to reach goals. Information is communicated, given and received. The act of communicating information is by itself a constituent part of humanity. As Gadamer remarks, it is a form of communality [297]. Finally, within the scope of the present study, information may not be considered as an utterly abstract idea in spite of its often intricate meanings and contexts of use. A notion made by Ward on texts as chunks of tacit knowledge, from which new explicit meanings are to be derived, could be argued to be also applicable to the more abstract idea of information [808, 69-70]. Information is obviously not tacit knowledge, but there is a lot of tacitness in its functioning.

The standpoint of the present study cites a systems theoretical viewpoint of information adopting, however, a qualitative point of view [465][466]. The basic assumption is to treat information essentially as a qualitative cultural property, which manifests itself as a contextual property of an abstract or a physical thing or a pattern. The notion refers to Bates, who describes information as "some pattern of organization of matter and energy that has been given meaning by a living being" [66]. The present study does, however, make a distinction between the information and the organisation, which either constitutes or embeds information. It is assumed that in a human context, the notion of organisation may be external or may seem to be external to the information itself.

Information is always information for someone in a given context [466, 592]. It is based on a state of being informed and has a capability to inform [398, 20]. It is important, however, to emphasise that the notion of meaning is understood here in a rather loose sense in contrast to the cognitive and constructivist viewpoints. Meaning does not have to embrace groups of actors or distinct known activities.[3] Rather, it is assumed to be capable of emerging always, when data is connected with other data. For Dervin, information and knowledge are verbs, which makes them to a "sense made at a particular point in time-space by someone" [228]. Thus it is assumed that to exist, information requires always someone or something capable of perceiving, or rather making, its meaning. Nauta points this out by describing information as a selectional power in a message, event or representation. The making of information requires a certain sensitivity to the message [543, 62][544]. The meaning has to be perceivable, but it does not have to be known. Correspondingly, an entity of information is basically a piece of data to anyone incapable of perceiving its subsumed meaning.

The present viewpoint acknowledges the existing heterogeneity of the propositions, which relates to the articulations of information. Following Hjørland [375, 35], all things are considered to be potentially informative, but information as such, is not seen as a thing (ref. [130]). In other words, as for Hayles, the "material objects are interpenetrated by information patterns" [355, 69]. However, it is argued that

[3]Like the information itself, the quality and value of information are considered to be subjective categories, even if in some contexts the value might be estimated or measured in quantitative [163] and explicit, for instance, economic terms [617].

information functions often as if it were a thing. It is perfectly natural for a person to act like information was a nearly physical object. Information is searched, it is treated like it would be possible to be handed over or bought when it is embedded in an artefact like a book. Similarly, it is possible to act like information would be quantifiable (cf. [466, 587][683]). Acknowledging this seeming paradox does cause some theoretical complications, but permits seeing information as we tend to see it. Information is not hovering in the air, but is socially and culturally attached to abstract and physical objects. The same viewpoint is emphasised by Hayles, who stresses that (within the scope of the present study: practical) information has to be instantiated in a medium to emerge [355, 75].

It is also argued that treating information as a cultural property (which may be, however, approached in a thing-like manner) is beneficial and necessary equally from the information systems design point of view. Information may be treated like it might be handed over simultaneously acknowledging, however, that the message will be necessarily obscured in the process. Information, which is fit for one person is bound to be at least partly unfit for the others. In spite of the emerging obscurity, the information may remain informative and comprehensible if the two persons share parts of the culture, which constitutes the property i.e. the information. The effects of the unavoidable errors and misunderstandings may be kept manageable if the distance remains sufficiently short and, especially, if the potential inaccuracy and plurality is acknowledged as a premiss.

The danger of resorting to the distribution of low-level 'information ingredients' is that the information processes become too costly. The shift of focus in the information sciences from information to knowledge and further on to the learning is beneficial, but risks to provide a general model for processing information, which is highly complex and expensive. No one can afford to learn everything. Much of the information has to be taken as ready-made 'things', not as building blocks. Jacob and Albrechtsen discussed the same issue and proposed American pragmatism as a philosophical basis for adapting to the evident plurality of propositions [408]. However, unlike a pragmatist viewpoint, the present study emphasises the significance of social and cultural contexts of information instead of its mere outcomes.

In summary, it is important to acknowledge that everything is not information. Accordingly, information is not necessarily information for everyone. In simple terms, if the meaning, which causes something to be information, is not perceived, the information ceases to exist for the particular actor in the particular context. Secondly, the standpoint of keeping information as a notion, which is perceivable as a thing, does not necessarily suggest that an information thing would be something physical or static, or that a piece of information would be comparable in size, extents or quality to another piece of information. 'Information as a cultural concept' is available through things, activities and presences. Information articulates, i.e. appears and becomes existing, for different actors, ceases to exist and disappears, or transforms to another form. The final important notion is to treat information as a pragmatic instrument, which is actually being used. In spite of its emphasis of subjectivity and contextuality, the present study considers that it is important to maintain the information as a notion with direct practical implications to human activity.

2.4.2 Knowledge

The diverse colloquial meanings of 'knowledge' often reflect a rather imprecise amalgam of notions, which are related to wisdom, understanding, data and information. Knowledge tends to incorporate the idea of a specific 'someone' who knows something and knows how to benefit of the knowing. The intricacy of the concept is not, however, limited to its everyday use. Even in comparison to the significantly ambiguous notion of information, the scholarly conceptions of 'knowledge' tend to express a notable variation.

Hjørland observes that the contemporary information science research has predominantly adopted a rather interpretivist standpoint [380]. On the contrary, any explicitly positivist, empiricist and rationalist notions of knowledge have become notably rare [375][840][380]. Following the lines of interpretativism, knowledge is rather typically perceived as a state of human mind, instead of being something external. Another constituent characteristic of the viewpoint seems to be an emphasis of the function and purpose before an information may be turned to knowledge. In accordance with this general notion, the International Encyclopaedia of Library and Information Science (2003) describes knowledge as information, which is processed and organised in human-mind to meet a purpose [263]. A concordant delineation written by Eriksson-Backa describes knowledge as "information that has been integrated into the existing knowledge base of a human being. A knowledge base is defined as the total sum of knowledge a person has". She concludes the definition by a functional remark that knowledge, which is understood in this manner "helps the individual to manage the surrounding world" [257, 12].

In spite of the existence of an apparent drive for consensus of the epistemological views, it is essential to remark that the common interpretivist views do not imply directly congruent epistemological verdicts. The general interpretivist views are shared by relativist [374] and radical relativist [345], phenomenological, cultural, hermeneutic, cognitive and postmodern viewpoints, albeit their intrinsic differences. Furthermore, as Hjørland remarks, the explicit interpretivist claims do not necessary imply an absence of positivist assumptions [380].

The debate on the inherent possibility or impossibility of managing knowledge exemplifies the intricacy of epistemological claims (e.g. [261][841]). A simplistic, yet rather typical stand, is to see knowledge more or less plainly as an elaborated or communicated form of information. This view has been especially popular in knowledge management [732, 3], but it has also had influence within the information science community [146]. According to this linearism, in an interpretivist light knowledge is perceived to be a contextual notion, which relates separately to the life-worlds of every individual. Knowledge is not seen as a static, but rather as a constantly changing structure [584]. Even though the constituency of the subjectivity, contextuality and volatily of knowledge, which is underlined by the linearism, bears considerable significance, it is difficult to approve that knowledge would be (simplistically) an extremely complex form of information. As Stenmark remarks [732], it is equally important to problematise the interrelations of knowledge, information and data, and not to see them merely as stages of gradually increasing complexity. The transformations between knowledge, information and data do not express causality, but rather a relationship of coexistence, mutual influence and contribution.

In this study, knowledge is seen as a contextual and dynamic phenomenon, which incorporates personal states of being informed and being able to benefit of the informedness. There is not only knowledge, but several knowledges (cf. [398,

20]). Simultaneously with the contextual characteristics, knowledge bears functional elements of knowing *how* and knowing *what for*, instead of merely knowing *what* [132, 11]. Following the notion of situatedness (e.g. [746]), knowledge is perceived to be always situated in a context, and more specifically, in an interface between individual actors (including individual human-beings, groups and machines), which is formed by their collective activity. Knowledge does not exist physically and thus it may not be seen as a thing, even though the acts of knowing and becoming to know may occasionally benefit of an artefactual presence and a use of material objects and tools (ref. [684]).

The assumed conception of knowledge does not fully subscribe the ISO 5127:2001 standard definition of information as "knowledge that is communicated" [403]. The constituent significance of communication is recognised, but the communicated matter is not seen as knowledge, but as its representation. Knowledge itself is not considered to be directly transferable. In purely practical terms, however, the ISO definition may be accepted as a workable simplification, because everything, which is communicated *about* a piece of knowledge, is mediated in the 'form' of information.

2.4.3 The information viewpoint

The idea of information construes in the present study to an explicit 'information viewpoint', which takes information as a cognisant starting point of investigating human activity. The relation of the viewpoint to, for instance, human or machine oriented viewpoints, is illustrated by a triangle, which incorporates human-beings, instruments and information (Fig. 2.2). The complete system of human activity grasps human-beings, tools or instruments and information. Here the three elements and their interrelations are explicitly viewed from the information point of view. Figuratively, the researcher may be imagined to be standing in the information corner of the triangle. The reasoning takes the information into the consideration both as a perspective to the other corners of the figure, and as a specific sensitivity to the role of information in the human-instrument-information interactions.

Byström presents a comparable figure, a pyramid, which depicts the research area of information needs, seeking and use (INSU). The present viewpoint differs from the perspective of Byström in the respect that here the entire research area is seen as being contextual. Furthermore, the *means* referred to by Byström are seen in the present study as instruments of reaching, managing and using information. Finally, the present research juxtaposes human-beings as individuals and as members of communities in their information activity (cf. [137, 15-16]). The present information viewpoint may be reduced to a perspective of seeing information as a cultural property and a fundamental substrate, which is present in all human activity. In spite of its occasional appearance as a 'thingish thing', the information is closer to a verbing of a process in which people are engaged, than an object or an instrument.

2.5 Work, work roles and information work

The concepts of work, work roles and information work are central in the current study of information and human activity. The following sections describe and discuss the concepts and their theoretical underpinnings.

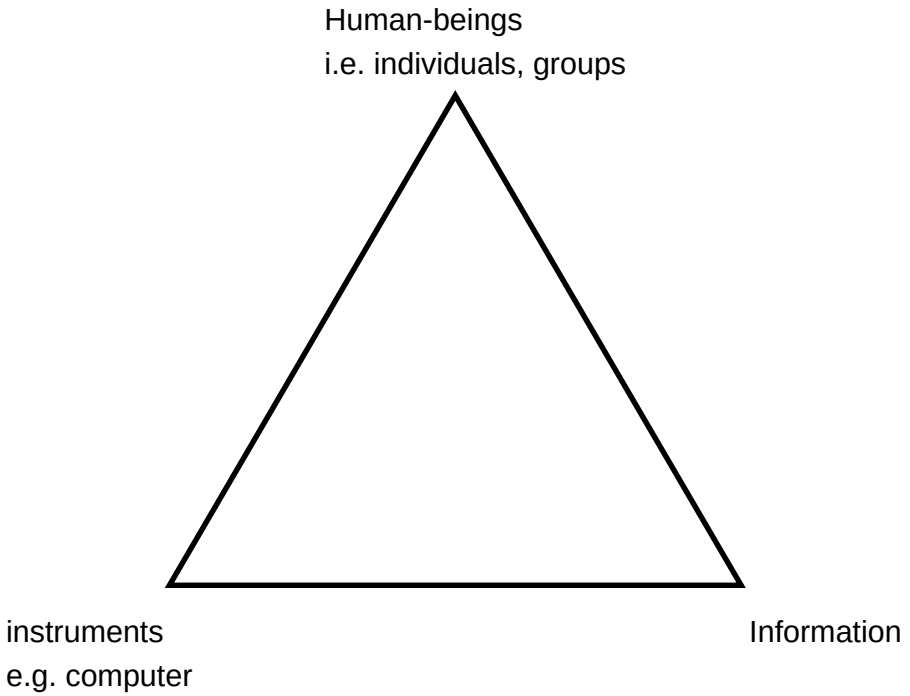


Figure 2.2: The information viewpoint

2.5.1 The concept of work

The present study assumes that 'work' is a distinct evolving set of inter-linked human activities, which has either explicit or implicit purpose, meaning and value. Work is a vague concept without a clear definition. The understanding of its objectives and implications differs between individuals. The work is construed through an individual and collective goal attainment, encodings and attitudes (ref. [125] [814][262]) as well as through a direct activity of organising and steering. Generally speaking, the understanding of the concept of "work" is normally shared in a community, but the understanding of any distinct instance of work as 'work', does not need to be shared in its entirety [723, 10-12]. An activity may be simultaneously considered by different individuals to be and not to be work.

The meaning of 'work' has been discussed frequently in the information sciences literature, especially with a reference to the Computer Supported Cooperative Work (CSCW) (e.g. [669]), human-computer interaction (HCI) [52] and information systems science (e.g. [306][557][433][776]). The present study acknowledges the relevance of several sub-conceptualisations, which spring from the different discussions within the information sciences. For the current study, the most prominent notions include the concepts of *cooperative work* [669], *articulation work* [740][719][669][189][748][558][276] and *invisible work* [719][747]. The focus of the perusal in the context of the present study is, however, on the general phenomenon of work, which grasps broadly the various modes of working, including the colloquial everyday work and work practises [135][433].

The concept of work adopted in the current study, is related closely to the notion of *work task* in the sense it is discussed in the information science and informa-

tion systems science literature (e.g. [306][723][138][398]). The role of 'work task' is emphasised in the currently rather prevalent approach of *task-based* studies of human activity and information interactions (ref. e.g. [723][138]). Both the notions, task and work task, are based on the same theoretical understanding of human actions and interactions. Basically a work task is a work related 'task' i.e. an 'atomic' (within each scope of perusal) meaningful activity, which is linked to a wider framework of 'work'.

The concepts of work and work task do share many functional characteristics to an extent that they do conceptually construct each other. As with work tasks, it is possible to discuss about work construction, work performance, and in a conditional sense, about work completion, as distinguishable phases of work [138, 1053-1054]. Compared to a work task, work is essentially a meta-concept, which is potentially inclusive of individually identifiable work tasks. Work is basically an upper level activity, which ties individual work tasks together and makes them 'work tasks' instead of mere 'tasks'.

Unlike a work task, work does not necessarily have to have a recognisable beginning nor an end (cf. [138, 1051]). Work functions on a long term cultural and societal level of activity. Besides being a meta-concept with respect to the work task, work is also a meta-process with respect to a distinct work flow. Work is situated not only in an instance of activity, but also in broader cultural contexts and situations. Work never consists of only one process. It is inherently an entity of overlapping, mutually non-exclusive processes. The purpose, meaning and value of a work task is in its relatively direct practical accomplishment [138], while the notion of the work focusses on the purposes behind an immediate objective, meanings behind the first explicit understanding and values above the value of a (relatively) short-term practical accomplishment.

Besides the constituency of the breadth of its cultural and temporal scopes, the concept of work builds on the notion of *control*. Control expresses a capability to guide and steer, rather than a state of an absolute possession.[4] In CSCW and social informatics oriented literature, the phenomenon has been referred to as *coordination* [447], which does effectively emphasise the collaborative and in a sense, 'soft', approach to the functioning of the control. The present view of the control and coordination assumes that they are not necessarily directional. Similarly, they are not necessarily organised in a hierarchical manner. Control is, however, perceived to be an important force for the work to emerge and exist. The practical implication of this view is an emphasis on the need to manage and actively organise work in order to increase its efficacy, and eventually, to make it exist. In the CSCW literature (e.g. [739][307][740][719][669][189][748][558][276]) this coordinative activity has been referred to as *articulation work*. The essential point behind the notion of articulation work is the cognisance of a need to articulate what is being done in a collaborative activity [307, 258 and 266]. The present study pushes the notion forwards and argues that the work occurs, because of the control and coordination, which are expressed through the articulation work, and that the work induces further control within its contextual and situated sphere of influence. The control frames work in a similar manner than the contextuality, albeit on a parallel level of modality to the context and situation (cf. Figs. 2.3 and 2.4).

The third important aspect of work (besides the notions of contextuality and control) is its cultural resonance and interwovenness with a distinct set of objec-

[4] I.e. the control is a central determinant of work, although in a less strict sense, than e.g. in the Marxist discourse of labour [810, 552].

tives. The hereby assumed concept of work acknowledges the importance of the Vygotskyan activity theory for the work studies (e.g. in [270]), although work is used here to emphasise the contextual and situational dimensions of human activity (i.e. purposes, meanings and values) rather than to explicate the activity itself. The present study places emphasis on a notion that the perceived qualities of meaning and value are not merely qualities, but constituent constructors of work itself. In spite of the importance of the cognitive, social and cultural dimensions of work, the concept is not used here as a merely cultural category. Work is perceived to hold the keys to the understanding of why anything is being done at all. The mission of practical information management and information systems design is to find efficient solutions for distinct sets of identified tasks. The scope of the present study, however, reaches beyond the task specific issues. This study scrutinises the functioning of work on a more profound level in order to inform forthcoming task specific efforts.

In summary, the concept of work is perceived in the current study as an articulation of four constituent factors:

1. Work is a collection of tightly inter-linked human activities with explicitly or implicitly understood purposes, meanings and values (Fig. 2.3).

2. Work is a process, behaviour and transient procedure, not a static structure. As a consequence, the analysis of work focusses on the issue of how and why the work functions and evolves, instead of describing the present state of affairs.

3. Work is a subjective concept. Its becoming and being are dependent on its contexts and situations (Fig. 2.3).

4. Work is conceived as being in a permanent state of making. Work *becomes* on the basis of its individual, cultural and societal meanings, values and purposes through an active articulation of control (Fig. 2.4).

2.5.2 Work roles and role theory

Role theory and the concept of 'work role' have been cited occasionally in the information systems and work related informatics literature. In the present study the concept of work role is used to refer to a distinct set of activities within a 'work' similarly as the 'work' is a distinct set of activities in a broader scope of human life-world. In accordance with Clifford, the present study considers a role as a concept with both abstract and tangible properties, but not as a solid theory [175]. A work role is not a job description and it does not reflect directly any existing organisation of work in a manner, in which the organisation is perceived by workers or their superiors. Work role is an analytical concept like the concept of work.

Various role based approaches have attracted occasional interest among the information science researchers (e.g. [480][709]). The viewpoint to the role theory, which is assumed in the present study, follows the steps taken within organisational theory, gender studies and cognitive psychology (with a special reference to the group roles) [142][5]. The roles are considered to be results of socialisation and contextual division of duties between abstract archetypal actors (instead of distinct

[5] Earlier studies on group roles, see e.g. managerial roles in Mintzberg (see e.g. [527] and [479]) or sex roles in the social role theory introduced by Eagly [244][245].

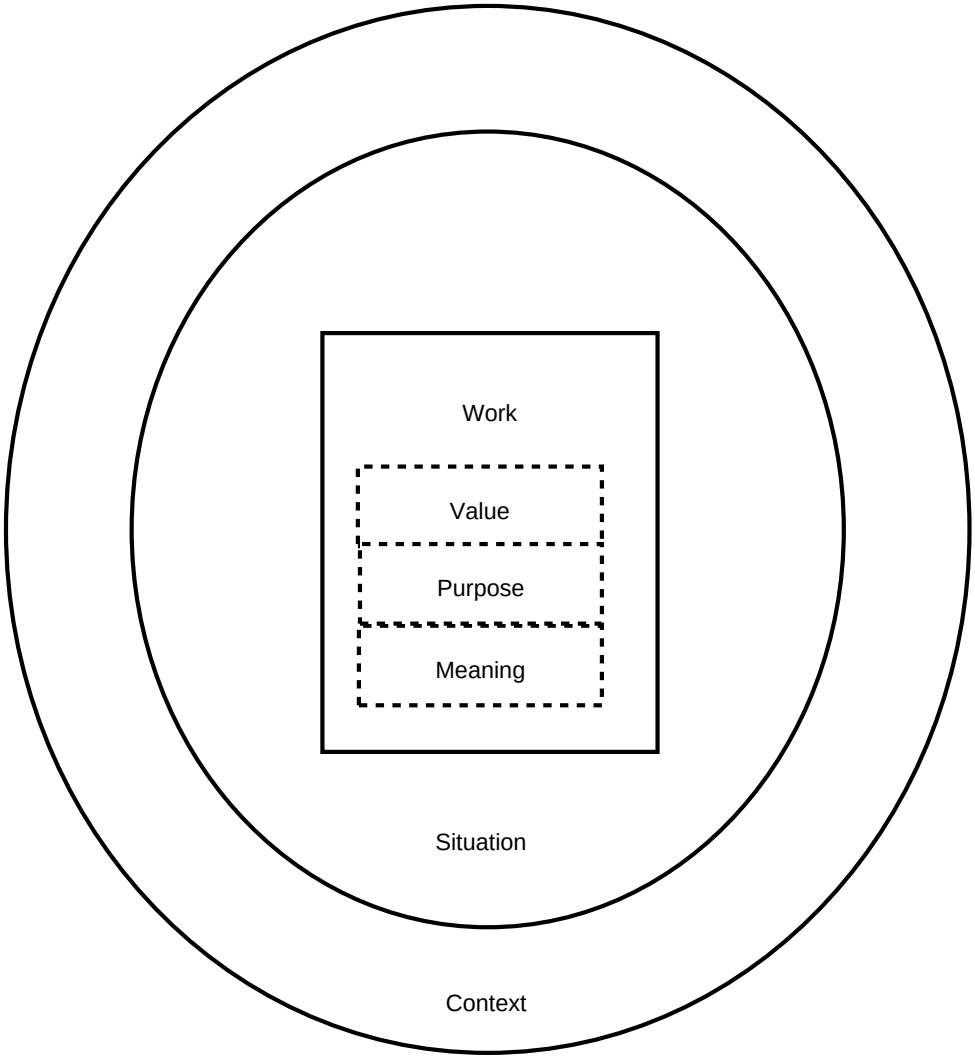


Figure 2.3: Work and its components in context

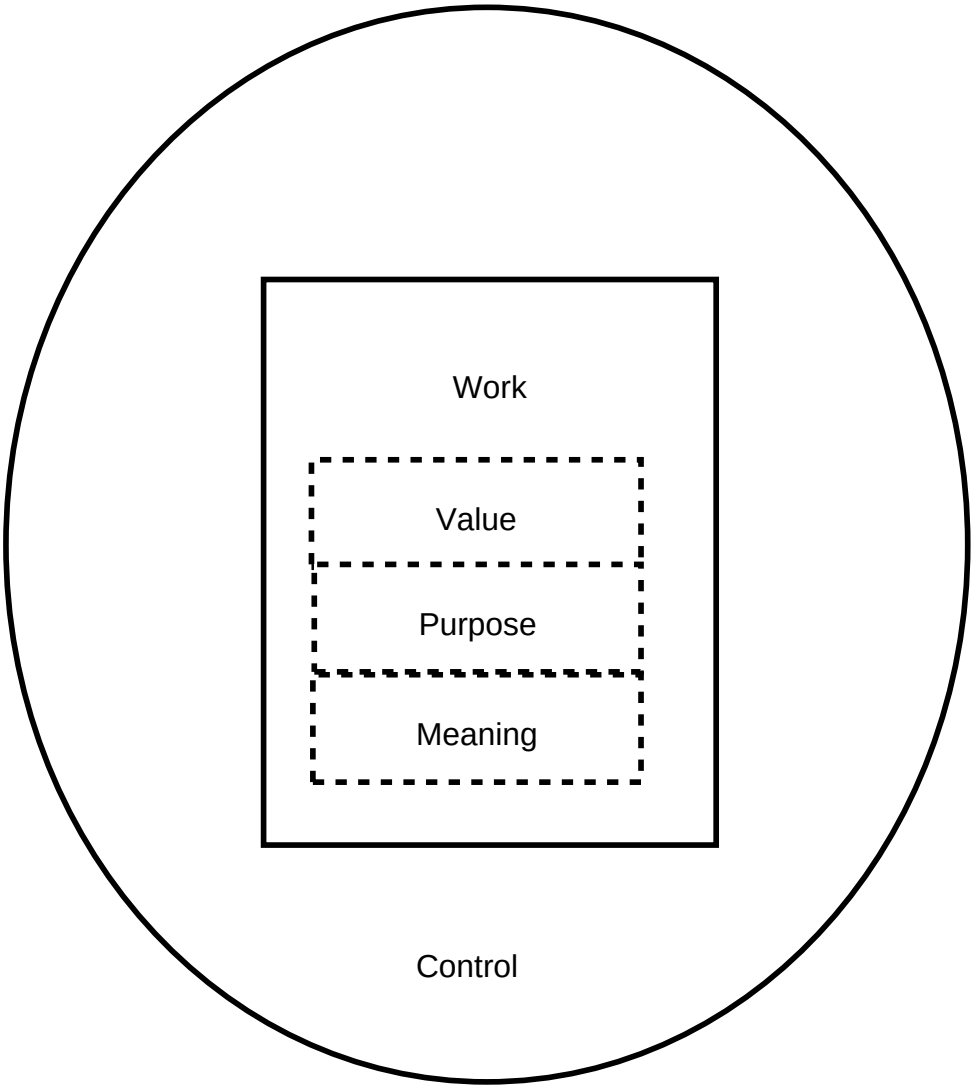


Figure 2.4: Work and control

human individuals). Therefore it is possible to discern individuals who are related to the different roles, but impossible to make any static assumptions that an individual is acting exclusively in a precise role.

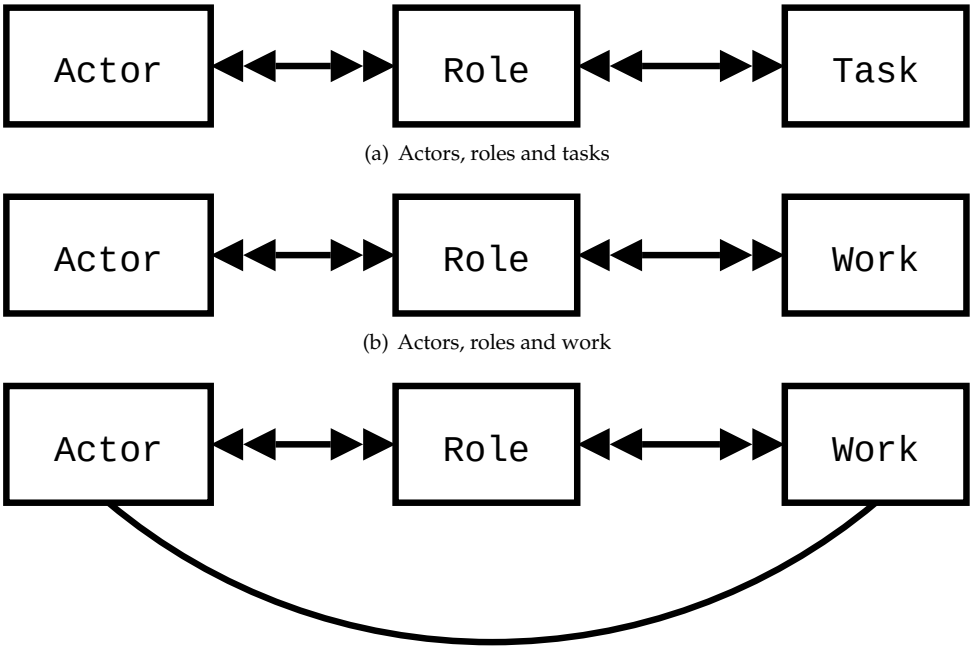
Role theory has been acknowledged to be a viable instrument for understanding the actions professionals take while they work [479, 109][558]. Work roles gained an especially prominent position in the Business Process Re-engineering (BPR) approach introduced by Hammer and Champy in the early 1990's [350]. The focus of the BPR viewpoint to the work roles is essentially on explicating the relations of business processes, individual work tasks and involved actors.

Besides Hammer, Champy and the subsequent contributions to work roles in the BPR context, the notion of work roles has been used by Nurminen and his students and colleagues [557][558] in several instances. Nurminen perceives work roles essentially as building blocks of the relation between the work and workers. An individual actor may have several work roles. Correspondingly a work role may be performed simultaneously by several actors. The relationships between the concepts may be illustrated by using the following many-to-many relation (from [558, 4, Fig.2], ref. Fig. 2.5(a)). Outside the original reference to the actors and tasks, in the context of the present study it is suggested further that one work role may belong to several tasks or 'works' (as the concepts are described in 2.5.1) and vice versa (Fig. 2.5(a)). The proposed conceptualisation explicates the link (between the actors and work), which builds on the existence of roles. It is important to emphasise, however, that this particular link is not an exclusive one. There is also a direct relationship between an actor and a task. This link denotes the personal and communal relationships between the individuals and all the undertaken work related pursuits, which are unrelated to their work roles (Fig. 2.5(c)).

The present notion of work role builds on the proposition of Gasser that it is often possible to discern a primary activity or work within the comprehensive spectrum of the work related roles and activities of an individual. This *primary work* addresses directly the purposes, meanings and values (agendas in [306]), which are conceived to be the most essential ones. The primary work related role may be expected to have a deeper impact on the activities of an individual. The primary work is also typically, yet not necessarily, reflected in the formal job descriptions and in the personal work related identities.

In spite of its partial formality, a work role is not a static entity. The dynamics of the work roles may be compared and illustrated by the concepts of genre and genre ecology of Spinuzzi. Similar to the genre ecology, the notion of work role refers to an inter-coordinated routine and official practises, which build on each other over time in order to emerge working solutions for recurring problems. Compared with a genre, a work role is perceived, however, as a broader concept. The work roles embrace the cultural dimensions of the activity in a more inclusive manner than the genres. They incorporate the notions of motivation, meaning and value of the body of the recurring and recognisable activities in addition to the activities themselves (cf. [716, 119-120, 222]).

The primary implication of referring to the work roles as conceptual relations, is the possibility of linking the work and the workers together. In the present study the work roles are a conceptual instrument for explicating and identifying different 'locations', where work, and more precisely information work, reside within the work processes. As Leckie and Pettigrew argue, the roles and the role theory have not as such, proved to be a sufficient conceptual framework for explicating the precise issues of information seeking and use [479, 110]. The fundamental problem of



(a) Actors, roles and tasks

(b) Actors, roles and work

(c) Actors and work

Figure 2.5: Role seen in connection to the actors and tasks, and actors and work (Fig. 2.5(a) from [558, 4, Fig. 2])

incorporating information activities and work roles, is that a role is a general concept in respect to the precise issues of information use. General objectives, which are associated to a work role, may be accomplished in various diverging ways. This diversity does subsequently imply a range of possible diverging information behaviours.

Considering the critique of Leckie and Pettigrew [479], it is important to remark that not only a work role, but also a task is a problematic concept in its precision. If a role is a too broad concept, a task risks being too narrow. A task level approach permits a precise explication of the issues of the information interactions, but takes simultaneously the scale of the perusal to a level, where the purposes, meanings and values of the complete effort become indiscernible. Individual tasks are in a risk of becoming isolated of each other and especially of the reasons, which originally triggered the more far-reaching process. The alternative information behaviours incorporated in the work roles represent a repertoire of viable activities and tasks for an information user even if their number is a complication for information scientists and information systems developers.

To overcome the limitation of precision and imprecision of the role based approaches, the roles are deconstructed further in the present study by using the concepts of *information work*, *use cases* and the *classification of information interactions* (ref. Section 6) as a framework of scrutinising the work roles on a more detailed level. In spite of the closer dissection, the focus is consciously retained on the level of work and work roles to maintain the emphasis on complete and meaningful processes instead of individual isolated actions.

In summary, the reason for focussing on work and work roles instead of tasks, is

a question of scale. The present study is concerned about sustained human activity, which lasts for a considerable length of time. The perusal is not centred around the completion of an individual instance of action or a limited series of actions performed by individuals. In contrast to a task-based perspective, a role-based approach makes it possible to study what is shared by the different individuals who work in different organisations in a time-span of several years.

2.5.3 Information work

The concept of information work[6] has been used in several different meanings. The most distinctive divide in the viewpoints about the meaning of the concept exists between the information technology centred and information or symbol centred approaches. Technological viewpoints consider information work as a work, which involves information technology, while the more abstract information centric definitions emphasise the role of 'information' and its epitomes [557, 169-171]. A third category of information work is the colloquial use of 'information work' and the related concept of 'eWork', which [411] denote explicitly information related professions (e.g. library, ICT, archives) [738, 4][593][699, 10][544, 161]. This professional view of information has become prevalent in conjunction with the information society and information economy debates [544, 161]. The professional notion may be argued to be somewhat superficial in its understanding of the concept 'information', and thus close to the technology centric viewpoint. The both perspectives share a basic standpoint of perceiving information as being situated in a set of very distinct artefacts (i.e. computers, books or archival documents). Another implication of these perspectives is that the information work engages only some specific groups of workers, not all of them.

Nurminen has plausibly argued that the abstract notions of information work tend to be more productive viewpoints within the context of socially and culturally oriented analyses of information and work, than the technological ones [557, 170]. The perspective of information work assumed in the present study, is based on a notion of information discussed in the Section 2.4.1. The approach is essentially classifiable as being abstract. The concept grasps all activity, which relates to the cultural-contextual category of information. Information work may be work in a traditional sense, but in addition, it may be used to refer to any other activity, which conforms with the notion of work discussed earlier in the Section 2.5.1. Unlike in the work system method (WSM) and similar information systems oriented viewpoints, the information work (system) is seen a constituent component of work (system) [21].

The concept of information work is related to the notion of knowledge work, which is, however, an equally ambiguous notion. In contrast to the information work, the knowledge work has been primarily used in economic and political contexts. Knowledge work typically refers to the notion of activities, groups of people and societies involved in knowledge intensive goal settings [564, 328-331][602]. The

[6]The concept shares several characteristics with the notions of *information culture* discussed by Ginman [318], Widén-Wulff [828] and Curry [205]. The principal difference between the two concepts is the emphasis on the purpose and consequential direction of activity embedded in the notion of information work. Information culture on the other hand, might be described as being a state of affairs in the process of information work. With its explicit references to the purposes, values and meanings, information work involves epistemic questions, research objectives and social considerations such as reputation building within the frame of information activities [295], and further the affective and cultural dimensions of human life.

same notion applies to the remark of Davenport and Prusak that "managing knowledge should be everyone's business" ([215, 108]), which refers to the importance of *knowledge management work* in organisations. With some exceptions (e.g. [99]) Both the concept knowledge work and knowledge management work might be argued to incorporate a slightly positivist subtlety of beneficiality, sophistication and externality. Information work attempts to avoid value judgements and to expand the contemplation to the level of individuals and their distinct activities. In the context of information work the premiss is that everyone is considered to be managing knowledge and information. The task of making everyone to manage knowledge or to do knowledge work transforms to a quest of finding ways how to incorporate this heterogeneous, personal and work related management and information work activity into the corporate practises.

Besides the knowledge work and knowledge management work, information work is characterised by several other related notions. Unlike Gasser's [306] *computing work*, which is otherwise conceptually close to the present concept of information work, the information work is not work with a 'thing', even though the quasi-physical view of information provides the information work a meaningful escape from the prison of invisibility. Information work is difficult to discern, because it does only seldom result to any obviously perceivable outcomes. Information work is also often far too obvious to become discernible, as for instance, the activity of 'creating meaning' while reading books (ref. [265, 91-92]).

Although the information work does contain an abstract dimension, it is closely related to the general concept of work. The assumed abstract notion of information work is largely faced with the same problems than the *invisible work* discussed by Star and Strauss [723]. Information work is embedded and layered, it is difficult to manage due to its various levels of articulation and its conditional visibility. Because the information work is largely 'invisible', it needs to be made explicit to become valued accordingly to its societal impact [719][747][723][750][749]. Otherwise an inefficient and ineffective information work risks becoming a major impediment in work processes.

A complementary implication of the embeddedness of information work is that it is never work for its own sake. Information work is always subjected to the goal settings and functions of the principal work. Information and information seeking is used to support work, not to be the purpose of the work except in very rare conditions [203]. Byström and Hansen denote information-seeking activities as sub-tasks for the primary purposes or goals of a work task [138, 1052] (ref also [139]). Respectively the information work could be described as being infrastructural, in contrast to the work, and being, in a sense, 'sub-work'. Using this notion as a frame of reference, the sub-work is sharing the contextual, purpose, meaning and value related characteristics of the principal work. It is not a system of its own. The information work is developing a set of its own motivations and values of its own besides the ones, which are shared with the primary work. The co-existence of work and sub-work specific and shared purposes, meanings and values is a source of their mutual dynamics. The two concepts, work and sub-work, appear to be inseparable, yet essentially dissimilar to each other within their mutual scope of existence.

If the information work is considered to be impossible to be fully conceptualised outside the scope of a 'work', an equally plausible claim is that there is no 'work' without information work. Information work exists in conjunction with all work from the traditionally information rich white collar work to the very basic

tasks of everyday life (ref. [738][99][259, 253][749]). The notion of the prevalence of information related interactions in all work emphasise the bidirectional relation of work and information work, where the latter functions as a particular kind of 'sub-work'. The constituency of information work within the scope of an instance of work underlines their mutual embeddedness on a motivational level. However, the complexity of the relation is not necessarily explicit and may appear as a subordinate hierarchy. Agreeing with the critique of Reddy and Dourish [612] on the artificiality of the treatment of information work as isolated from the concept of work, it seems impossible to consider the information work as anything more tangible than as an abstract conceptual emphasis of the role of information in various tasks of human life. Yet as the import of the information is emphatic in the contexts of work, the information work remains a relevant notion of discussion and research. The relevance of studying it becomes especially underlined in the context of an explicit information oriented viewpoint, which accentuates the analysis of the information specific issues in the context of work (cf. e.g. [259]).

The immediate benefit of referring to the concept of information work is its capability to incorporate the temporal dimension in a similar manner to the notion of information search process put forward by Kuhlthau [460][676] (case 3 in [663]). In addition to the notion of information process, the concept of information work does also grasp the notions of contextuality and simultaneous existence of the different explicated dimensions including culture, society, context, time and space. As Fry underlines, the information practises are a lot more than the explicit activity 'with information'. The notion of information work addresses these implicit and invisible practises with their explicit references to the purposes, values and meanings of the activity.

2.6 Systems theoretical viewpoint

The immanent difficulties of bringing concretia to the concept and phenomenon of information work urge for practicable methods of deconstructing the work, its contexts and premises in an organised manner. Work and its components are not related to each other in simple linear chains, nor as a completely undecipherable mess. Work follows certain, although often merely implicit, rules and codes, which relate to each other in complex, but still organised processes and chains of actions. In spite of its seeming randomness, the human work tends to present a degree of coherence and attain some scripted objectives.

The following sections describe the systems theoretical framework of the present study. The viewpoint is used in the analysis and explication of the hidden and explicit systematics of work. The approach builds on the Soft Systems Methodology (SSM) introduced by Checkland [156][157][160][158] placing a special emphasis on the implications of its post-structural stance. In systems thinking terms, the assumed standpoint is 'human-centred' instead of being a formal one. The framework of SSM is discussed with the notions of information behaviour and information horizon. It is assumed that the 'work', as a purpose, meaning and value oriented activity, forms a theoretical system encompassed by (in a relative sense) multiple secondary, mutually overlapping systems. Within this framework, the concepts of information behaviour and information horizon are considered to provide a context for establishing the positions of human and non-human actors and their activity.

2.6.1 Systems theory

The Soft Systems Methodology (SSM) is based on the broader framework of systems theory (or systems approach, systemics). Systems theory is a large interdisciplinary project, which ranges from biology to computer science and sociology. The basic notion of the broad meta-theory of systemics referred to as the *General Systems Theory* [804] is an attempt to understand the nature of large and complex systems [804]. The precise viewpoints, applied scholarly apparatus and the understanding of the scope of a 'system' vary between the different implementations and versions of the approach. A basic conception of the systems oriented approaches has been that they are 'hard'. In spite of this premisory assumption, the systems theory and systems thinking have been demonstrated to have potential also in the human-centred research [470]. Broadly speaking, the systems theory polarises into *holistic* (or humanistic [557, 28], or human-centred [660, 1057]) and *analytic* (or formal) approaches [557, 27-28]. The first is characterised by a descriptive viewpoint and a concern for human issues and holistic entities, while the analytical approach represents a formalised reductionist attempt to enter deep into the components and processes of the examined system [557, 27-28]. The human-centred standpoint perceives systems theory (or thinking) as a broad referential framework instead of an axiomatic standpoint, which is typical to the formal systems centred viewpoint [660]. The same distinction has been referred to as a division to 'soft' and 'hard' traditions [159, 48, Table 2.2] of the systems theory. On the level of individual contributions and scholars, the division becomes less evident. In spite of their human orientation, the practical approaches tend to cite hard techniques and ideas, while the descriptive approaches draw closer to the holistic paradigm even if their basic worldview was plainly formal. The Soft Systems Methodology [157] is an illustrative example of a holistic approach, which still relies on 'hard' methodologies when it comes to the practical design of information systems.

In spite of its evident possibilities, the systems approach has faced warranted critique. The first crisis of the systems thinking was caused by the introduction and acknowledgement of the importance of the human factor [557][159, 46-47]. Soft systems and the so called 'descriptive' systems theory was a direct response to the imperative of incorporating the human actors and organisations, and the notion of endemic fluidity into the systems approach [157]. The critique does not directly imply that the analytic approaches are deficient as such. However, as Wilson illustrates by comparing two issues of 'a flat tyre' and of 'the Northern Ireland' [829, 7], the hard (a flat tyre needs a mechanical reparation) and the soft (the unrest in Northern Ireland is a cultural and societal issue) problems require distinctly different approaches. The same observation applies to the systems theory in general. The grand disappointment to the theory during the early 1980's was caused by an apparent failure of the promises that the systemics might provide a universal theory for the social sciences [466, 581]. The systems theory provides applicable framework for discussion, but its axioms are "too fundamental to work in practise" as Smith pointed out [699, 126]. The significance of this remark is that even though the approach will infallibly fail to model the precise behaviour of an individual, the systemics works well as a framework for structuring and organising activities and processes on a more general level.

2.6.2 Systems thinking in information science

Systems theory has had a considerable, even if not always quite explicit impact on the information science research. Various systems thinking oriented approaches has been applied to the practical information work and information management since the 1960's [90][183][332][467][631][191][16]. Formal systems theory has been utilised especially in the pronouncedly systems-centred research areas of information science: information systems, technology and information retrieval research [660, 1057][167][201]. The gap between systemic and human-centred approaches has inspired several comments on the possibilities and necessities of bridging the two viewpoints [69][660][789][270][714]. Julien has made some critical observations on the lack of addressing affective issues in "the systems oriented literature in our discipline" [424][425, 456]. Even though the (information) "systems oriented literature" is not altogether a fully unambiguous concept, it is clear that the affects like other human issues seem to remain somewhat isolated from the information systems development oriented contributions.[7] The lack of interest in human issues may not be warranted by an unsuitability of the systems thinking approach in the human contexts. Rather it seems to be symptomatic of the perpetuation of the technological tendencies in the prevailing research frames.

In the same manner as human issues seem to have been treated scarcely in (information) systems oriented literature, the systems theory has been used relatively little in the human approaches. The holistic systems thinking has gained some ground in the human-centred information science and information systems scholarship, although direct references have remained infrequent after a slight initial enthusiasm in the early 1980's [699][513][499][503]. Human-centred scholars such as Bates [69] and Dervin [227] have made occasional explicit references to the general systems theory. The remainder of the reflections of a systems oriented stance in the human centred research have been confined to a number of references to the secondary literature, such as to the Batesonian theory of communication [70], which draws from the holistic systems approach.

The relative unpopularity of explicit systems theoretical research designs may be explained by a variety of factors. One plausible delineation is to take the rareness as a symptom of the debate between human versus system orientation. As a consequence, it seems that the systems theory has been quietly left to information systems science simultaneously with shifting the focus of information science towards other areas of interest. At the same time the concept of "systems" has been synonymised with tools, instead of systems thinking oriented studies, a tendency which Alter criticises [22]. The eventual scholarly motivation for the unpopularity of the systemics is rather vague, because the systems and process oriented approaches are strikingly prominent in the analytical constructs of the information research, even if they are cited less frequently as a part of the theoretical framework. The various processual models of information behaviour may be kept as the most obvious examples of the tendency (e.g. [833][839][836][589]). From both the explicit and implicit points of view, the systems approach bears without a doubt, a potential to contribute to the information science research beyond the scope of the present contributions. As Hjørland remarks, the approach deserves to be considered more thoroughly [379].

[7] With the exception of e.g. Picard [590].

2.6.3 Systems and infrastructures

Systems thinking may be described as a project to bring formality to the perusal of the structures and functioning of the human and sociotechnical organisations. The systems approach makes it possible to penetrate the patterns of work and make them explicit.

A system incorporates both explicit and implicit functions and characteristics. The explicit functions and characteristics are evident in the context of system and its operation. The implicit level consists of substrates, which are necessary for a system to function, but are not a topic of the process. In a colloquial world, these substrates, or the *infrastructure*s, comprise, for instance, roads, railway lines, plumbing and electrical networks. In non-technical human systems, the infrastructures and infrastructure-like substrates are often more difficult to discern. They are invisible or semi-invisible functions, structures and patterns, which can not be removed in order to maintain the functionality of the system. Following the proposition of Star and Ruhleder, the present study considers an infrastructure to be a relational property [722]. Star and Ruhleder summarise nine essential characteristics of an infrastructure. The examples are derived from the empirical findings of the present study discussed in detail in the part II.

1. *Embeddedness*: Infrastructure is inside other structures and processes. An infrastructure is often difficult to discern and identify within the entirety of a structure. In the context of the present study, the informants found it difficult to specify their tools and the components of their work. The components merely existed inside the larger framework.

2. *Transparency*: Infrastructure is transparent to use, it does not need to be reestablished or invented anew. Experienced informants stated that they often 'know' where to find information even when they are unable to tell precisely how. Consequently, due to the transparency, it is often difficult to understand that the information seeking procedure is not transparent to a newcomer.

3. *Reach or scope*: The notion applies to a dimensional or contextual space. Work tends to organise itself in temporal and spatial intervals. Projects, organisational rhythm and the areas of work (e.g. one town or city, the office, one building) structure the organisation of the work system.

4. *Learned as part of membership*: Infrastructure may be internalised only through participation. For outsiders an infrastructure is an object, but becomes an indiscernible part of the work for the insiders.

5. *Links with conventions of practise*: The notion is embedded in the idea of how the things are done and how the things are. A system fashions and is fashioned by organisational conventions such as the assumed documentation methods, particularities of the instruments and the timing of the coffee breaks.

6. *Embodiment of standards*: Infrastructures function as interfaces between different possibilities and approaches of performing activities. Archaeological work implements many explicit standards such as the Harris matrices to represent stratigraphical relationships and more implicit ones such as the conventions of how a field notebook is typically laid out and filled.

7. *Built on an installed base*: Infrastructures are contextual structures. They do not come out of nothing. They evolve on the available structures and premises.

8. *Becomes visible upon breakdown*: Infrastructures become visible only if they fail or cease to function. Internet use is a typical example of an invisible infrastructure in the contemporary society. Very few of the informants indicated that they browsed the web very frequently, but agreed that their work duties did indeed require the existence of a fast and an uninterrupted connection.

9. *Is fixed in modular increments, not all at once or globally*: Infrastructures are complex phenomena with multiple 'significances' in different local contexts. As Star explicates the matter, "nobody is really in charge of an infrastructure" [722]. It is impossible to change or control from above. It rather evolves and changes in a semi-autonomous manner.

For the present study, the relevance of the infrastructures is in the notion that the systems of work and information work are dependent on their underlying infrastructures. The infrastructures need to be identified and made visible to make a meaningful understanding of an entire system and its functioning possible. A careful description and support of the explicit activities (*master narratives* in Star [722]) of the work does not keep the system alive, but they are necessary for establishing the understanding. Besides foregrounding the role of the master narratives, Star proposes that the infrastructures may be made visible through surfacing invisible (i.e. infrastructural) work [723] and seeking out the paradoxes of tiny barriers and manifestations of the human tendency to maintain the assemblage of work in spite of the related costs [306][720]. The infrastructure becomes occasionally visible in artefacts, in the flow of activities and in its visible trails, but not necessarily in a explicit manner [720] without a cognisant process of making it visible by explicit articulation.

2.6.4 Soft systems theory and information work

Like the 'soft' systems approach as a whole, the viewpoint assumed in the present study is emphatically 'holistic' and 'humanistic'. The approach follows the basic lines of a tradition referred to as the (soft) systems thinking [157]. The fundamental quality of a soft (i.e. human) system is its complexity and fluidity compared to an artificial (e.g. computer) system [157].

The present study perceives human work and information work as systemic phenomena. The systems thinking is not, however, suitable for an inclusive analysis in the context of this particular study. It is, however, practicable as a complementary measure and as an appropriate theoretical framework for understanding organisations in order to make judgements and decisions about them. Furthermore, the approach provides a basis for identifying and managing the eventually experienced problems and incoherencies in the systems and their functioning [699, 28].

Like the soft systems in general, the systems discussed in the present study do not exist in the physical reality. They do rather represent a way of perceiving and understanding the real-world activities [157]. Earlier the SSM made a clearer distinction between the 'real-world' and the 'systems thinking about the real world' [157]. Since the early days Checkland has began to argue for the beneficiality of a somewhat less explicit distinction [161]. It is assumed that any system under inspection is always a construction made by an analyst, and thus not a real-world system. The later precision made by Checkland is of importance, because the assumption of an existence of a 'true' real-world system would not stand the subjectivist critique of the socio-cultural theories. A pragmatic middle position is to

assume that any representation of an analysed system is not precisely real, but it might be an estimation, which is close enough to a subjective reality, to be usable.

The primary implication of perceiving a system as a subjective reality, is the possibility of incorporating individual perspectives into a single systemic framework. This assumption leads to an essentially postmodern standpoint, in which only complexity and transition are sustainable. There is not one system, but an unlimited number of systems. By the same token, there are always systems consisting of other systems in a manner, which negates the possibility of defining an absolute hierarchy of their subpositions and superpositions.

The systems approach distinguishes nine attributes in systems (derived from [220, chapter 2][5]):

1. Systems have boundaries, which distinguish them from their environments.
2. Systems have inputs and outputs.
3. Transformations occur within systems (e.g. transforming inputs to outputs).
4. Systems have monitor and control subsystems.
5. Systems relate to other systems and consist of subsystems.
6. Systems exhibit homeostatis, they try to revert to a stable state.
7. Systems tend to resist entropy.
8. Systems have a purpose.
9. Systems have emergent properties, the whole is more than the sum of the parts.

These attributes have several implications for the systemic understanding of the notions of work and information work. In spite of the complexity of the notion of 'work' (ref. 2.5.1), it is argued that the work is distinguishable in its context **(1,** ref. to the list above**)**. The act of distinguishing is subjective and therefore the system is necessarily distinguished and defined simultaneously in an indefinite number of instances. Consequently, to affect the work, it is necessary to consider various, both official and unofficial, standpoints and wider cultural contexts as Rassau emphasises [611, 362].

Work is provided by a set of inputs and it is expected to produce a set of outputs incorporating a transformation in the middle. Information work has inputs and outputs in the form of information, but also in a less explicit manner as indirect influences in its context **(2, 3)**. The existence of monitor and control subsystems translates to a process in which the work controls itself and is aware of its state. Work is not haphazard. It functions according to a specific set of rules and guidelines, even though it is acknowledged that identifying the control and monitoring systems within a work is a complex process **(4)**. An instance of an individual 'work' system consists of multiple other 'work' systems, which occur in relation to each other. The relations are not necessary hierarchical, but tend to express a form of organisation **(5)**. According to this organisation and functioning of parallel mutually controlling and monitoring systems, the work tends to resist fast changes and disorganisation **(6, 7)**. Work and information work tends to revert to the previous conditions and procedures, which makes the organisational change a challenge.

As already underlined, a work has a purpose besides the subjective qualities of its value and meaning **(8)**. The final notion that work and information work are more than the sum of their individual parts, is of a special importance **(9)**. On one hand, this assumption fits together with the claim that work and information work are significant categories, because they may be expected to be able to produce added value in individual activities. On the other hand, the available components of work and information work are capable of producing more and better results through a functional organisation and processing. In the context of the present study, the implication translates to a fundamental proposition that it is possible to 'cause' more information through a careful management of information work and to provide efficient means to manage existing and forthcoming information repositories.

In summary, the motivation for adapting a soft systems approach to the study of human information activity in the context of work and information work, is the possibility of bringing structure to the 'soft' observations and conceptualisations of the human behaviour. Another implication of the systemic viewpoint is that it is feasible to attempt to *manage* and *organise* soft systems such as work or information work, whereas the *controlling* or structuring of these dynamic and complex notions is impractical, if possible at all.

2.6.5 Ecological approach

The systems have boundaries between them, but neither the systems nor the boundaries are static. The systems have a tendency to resist entropy and to revert to the stability. Systems change in accordance with their internal dynamics and the influence of their surroundings in a process of seeking out new states of stability. The different systems affect each other and themselves allowing and disallowing certain behaviours in a manner, which is not random, but which tends to follow identifiable guidelines.

The internal and external dynamics of technological and social systems have been compared to ecological and evolutionary systems. From the information point of view, the most interesting propositions have been made by Bateson (the ecology of mind) [70], Nardi and O'Day [539], and Davenport (information ecology) [214]. The ecological approach emerged largely as a critique towards the mechanical views of human systems (ref. Section 2.6.1). The ambition of these considerations have been to underline and utilise the resemblance of the characteristics of change in artificial, social, cultural, and the literally 'natural' systems. The present study employs an approach titled *information work analysis*, which is directed to explicate the factors, which cause and affect change in the systemic contexts of information work (cf. Section 2.8). Information work analysis is directed to yield information for the management of these factors and the consequent changes. The approach refers to two *ecological notions*, which are based on the analytical resemblance of the characteristics of the natural and socio-cultural systems.

The first ecological notion assumed in the present study is that **1) the systems of human work and information work are ecological by their nature**. The assumption follows the conception of information ecologies proposed by Nardi and O'Day [539]. Information systems and information structures form an ecological entity. The concept of information ecology is seen as "a system of people, practises, values, and technologies in a particular local environment" [539, 49]. As Hart-Davidson notes, the approach is a mediating standpoint between technological determinism

and the "indifference" [353] of entropy and hyper-relativism. The present study does not confine itself to any particular local environment. It subscribes a notion of an extended locality in distance through the contemporary communication media. In the context of the human work, the 'local' needs to be defined in the context of the scale of the system. In a local system the locality is small while in a global one, the local expands to grasp the whole world or some extended parts of it. Similarly to the basic ecological notion, also the subsequent characteristics of the information ecologies, including their systemic nature, diversity, co-evolution and keystone species (the skilled individuals whose presence is necessary for the system [539]), may be pointed out in the systems of work and information work.

The second ecological notion relates to the manner, in which the ecology of the system affects the behaviour of its affiliated actors. The **2) systems permit and encourage some activities simultaneously prohibiting and preventing some others.** These factors are often referred to as *affordances* and *constraints*. The concepts are rooted in the ecological approach of Gibson, which originates in the context of cognitive psychology [311][312]. The notion of an ecological constraint refers to the structures of the external world, which guide the human action, in contrast to the persons' internal cognitive processes. Gibson uses 'affordance' to denote "what an environment offers an animal, what it provides and what it furnishes" [313, 127] (ref. also [311][312]). The notion of affordance is for Gibson essentially a matter of relation between an organism and its environment. It implies the complementarity of a being and the environment. Gibson argues further that the affordance cuts across the dichotomy of subjective-objective and enables us to perceive through its inadequacy [313, 127]. It is both physical and psychical, yet being neither in its entirety [313, 127]. Summing up the complementary observations made by Baerentsen and Trettvik, the affordances exist in temporally extended interaction relationships [49]. Perception of an affordance is a perception of interactions and relationships.

Baerentsen and Trettvik observe that the cultural [49] or in other words, the social-historical dimension (ref. [12]) of the affordances and constraints is a somewhat weak notion in the writings of Gibson [49]. Baerentsen and Trettvik make a sharp distinction between the unintentionality of the physical properties in the natural world and the artificiality of the cultural world, maintaining, however, a relatively artificial division between the 'natural' and the 'cultural' while discussing the issue. This notion bears some meaning in a theoretical sense when discussing the ecological approach in the non-human versus human, i.e. cultural contexts. As a whole, the approach is, however, rather problematic. The concept of culture and artificial design of objects do not apply to the most of the natural world, but every situation of use may be argued to suggest a theoretical intention even if a situation is without any human involvement. Thus it might be further suggested that the affordances and constraints function through an amalgam of physical properties and their cultural interpretations. Perceiving an affordance is a matter of common acceptance and, if interpreted through the frame of the activity-theory and cultural-historical psychology, a matter of an inclusion in a community of societal forms of praxis as Baerentsen and Trettvik point out [49]. In more general terms, the capability to understand affordances and constraints may be thus argued to be a question of an existing cultural contract, and essentially of a common shared knowledge base.

Of the two Gibsonian concepts, the affordance has been widely popular in human-computer interaction (HCI) research especially since the publication of the influen-

tial *The psychology of everyday things* by Norman in 1988 [554].[8] However, the understanding of affordances in Norman and especially in the later HCI literature, differs rather significantly from the original Gibsonian notion [49]. The references to the ecological approach in the HCI literature have been criticised of referring to affordances in a simplistic and an acontextual manner as 'direct invitations' to act in a distinct manner. The reading omits much of the originally salient point of ecology [49][633, 101]. In spite of the critique, the HCI researchers, who discuss the complexities of human - information system relationship in terms of affordances, have to be credited with placing emphasis on the need to articulate user and usage issues in information systems design. The same issues are no doubt, of importance also in the context of the current discussion concerning the implications of the information behaviour based studies and the design issues of information and knowledge organisation (ref. Section 9.1). Knowledge organisation systems are, nonetheless, first and foremost meant to be usable instruments to the humans (ref. Section 3.1.1). The present study assumes a notion of affordances and constraints, which is basically more closely related to the approach of Gibson than to the one of Norman. This study acknowledges, however, the importance of the cultural-contextual contract and the user perspective underlined by Norman. The affordances and constraints form a relationship between a being and its environment, and more precisely in the context of the present study, between a human-being and the infrastructures of work and information work.

2.7 Embeddedness and complexity: information work and information behaviour in the age of the post-modern

The complex embedded nature of information work and work calls attention to the practicians of the work and their behaviour. It is important to understand the actors and their roles within the scope of the entire project of work and the resonance of information work as its component. This understanding is needed in order to be able to explicate and understand the complex systemic relationship of actors, information work and work in a productive manner.

A basic assumption of the present study is to perceive information work as a sub-work (discussed in Section 2.5.3). The sub-work does not exist 'physically', but it does nevertheless bear diverse implications to the work and the workers. In that respect, the information work may be described consequentially, from the actor point of view, as an articulation of the various information related activities and considerations in the context of work. It is assumed that the context of work embraces the current situation and the work itself with its broad intellectual and physical surroundings. Besides the work and its contexts, the articulation of information activity becomes simultaneously dependent on the personal behaviour of the individual human and non-human (e.g. machines and information systems) actors. The implication of this conceptualisation is that the observable information work is a result of a double articulation. The information work articulates both the patterns and the purposes, meanings and values of the related work, and the characteristics of the individual information behaviours of the participating actors.

[8] On the contrary, the notion of ecological constraint has received little attention, possibly at least partly because of their immanent existence in typical usage contexts, i.e. computer systems being blamed of restricting various user tasks.

The following sections describe the perspective of the present study to the perusal and articulation of information work and information behaviour. The framework follows closely the notion of the anthropology of knowledge discussed by Burke [132, 81-82]. The focal aspect of the approach is in studying the use of information and knowledge by placing a special emphasis on cultural relativity, cross-cultural comparisons and the relevance of contexts, following the lines of the anthropological theory (ref. [18]). Anthropological concepts and anthropologically informed research methods have been used earlier in information science [280][672][676], although the influence may be argued to have been the most substantial in the development of the field methods rather than in forming a basis for the development of theoretical viewpoints. The influence has been somewhat more intensive in the information systems science largely because of the widespread attention received by the groundbreaking works on information systems use written by professional anthropologists and ethnographers (ref. [746][46][448][751]).

2.7.1 Anthropological viewpoint and the information work studies

Since the emergence of a special interest in the anthropological and ethnographical studies of work, human-computer interaction and information activity in the 1980's, the paradox of these user oriented work place studies has been the persistent difficulty of applying the acquired understanding in practise. As Rogers observes, the anthropologically informed interview and observation based analysis techniques have contributed relatively little to the development of new systems and frameworks [633]. In spite of the somewhat unimpressive record of directly applicable results, it is necessary to stress that the work place studies are also of practical significance (ref. [299, 428-429]).

Schmidt acknowledges the importance of the work place studies (within the Computer Supported Cooperative Work, CSCW) and the anthropological viewpoint as an especially viable method for replacing prevalent common sense assumptions with a solid understanding of the actual patterns of work. He is, however, more critical towards the applicability of the approach in the design of the CSCW [668, 149].

The simultaneous strength and weakness of the work place studies both in CSCW and in information science, is their elaborateness and their tendency to stress the contextual situatedness of the findings. It is true that an ethnographical investigation is not representative outside its context. The studies are, however, capable of informing about cognisance, emotions, structures and patterns of activity, which may express similarity with comparable phenomena in other contexts. A work place study is not fit for providing technical specifications of how the things should be designed, but it is capable of informing about conceivable future challenges and other matters to what an organisation should be prepared. This kind of information is not especially useful in the practical design and development work, but it serves well as a basis for management decisions, including the ones, which are central in the management of information and information work.

Due to the situated and contextual nature of the work place studies, the exploitation of the findings needs to be warranted by the recognition of their particular characteristics. The following aspects of the findings are perceived to bear a special significance in the context of the present study:

1. **All human-information interactions are ubiquitously complex**, which im-

plies an impossibility of having definite answers. Therefore the feasible approach to address the human issues is to try to understand and to build on the acquired understanding. For instance, the low usage of formal information services might be a "disappointing fact" from a service providers' point of view [376, 430]. The user behaviour is difficult to change in a trice, but the "fact" might still be managed e.g. by marketing, user education or development of the services.

2. **All 'entities', which are involved in the information interactions are active participants, and thus actors in the process.** Similar to the human actors, the instruments and the information are, in a sense, actively affecting the interaction and shaping each other.

3. Due to the omnipresence of participation in the interactions, it is necessary to **focus on the actors, their experiences, interactivity, and the interfaces** in between.

4. Besides being complex as such, the **information activity is evolving constantly** due to the influence of the different participating actors, and the changing contexts and situations.

5. The **information activity is constructed on different premises in different contexts**. Similarly, **the activity manifests differently in different contexts, cultures and surroundings**. Comparisons between the different actors and contexts are possible, but only at an indicative level and with a considerable sensitivity to the context and situation.

The first aspect **(1)** underlines the principal lesson of anthropology in the present context: the emphasis on the necessity to acknowledge the complexities of the studied subject within its social and cultural contexts. It is important to make an issue of the manner in which people do perceive and organise information. Similarly, it is important to explore precisely the meaning of any prospective tool in its context of use before making any assumptions about its functions or usability [595, 476]. The anthropological viewpoint assumes that a researcher has to defamiliarise the subject of the study in a conscious manner, treat it as distinctly different from the present context, and assume that there is a plurality of subjects around. In a sense it would be preferable to write about knowledges and informations instead of using the concepts in singular. The observations tackle multiple embedded, interlinked, overlapping and parallel cultures instead of 'a culture' (cf. [298]).

However, in spite of this fundamental renouncement of the possibility of a single objective 'truth', the viewpoint of the present study refuses to denounce the pragmatic standpoint of a relativist 'modern science' and the possibility to establish and employ a 'truth', which is more plausible and practicable than the other propositions. These 'working structures' serve as pragmatic approximations, which are capable of functioning as a consensual fact for a group of people. In an essence, the hereby assumed viewpoint may be described as postmodern and post-structural, but not as ultra-relativist.

The second aspect **(2)** contrasts the viewpoint of the present study with the individual-centric approaches. This study recognises the significance of the cognitive viewpoint (ref. [81]), but refuses to take the cognition as its predominant foundation. The present study emphasises that besides the cognition, the information and context have an active role in the information activities (ref. the critique

of 'all-inclusive mentalism' [292]). Even if it is convenient and practical to discuss by referring to such concepts as the information needs, information production, information seeking or information retrieval, this study emphasises that the information and contexts are actively constructing human activity, not only vice versa. The information activity is not only a question about a person being a consumer or a producer of information, but it is also about the information 'being' beyond the simplistic notion of commodity (e.g. [293]). The notion does not presume environmental determinism, but rather underlines the active role of all participants, including the human-beings, tools and the information.

Due to the focus on the activity of participation, the present viewpoint is interested in both the human and non-human actors. The third emphasis **(3)** is placed on the interactions, experiences, and the ways of experiencing (i.e. conceptions) through being aware of something (similarly to the phenomenography, ref. [490]). The differences of the information activities may be explained according to the approach, as different ways of experiencing the activity. It is suggested that articulation (i.e. making explicit) of information and participation in an activity are instantiated through these acts of experiencing, and sharing and exchanging experiences.

The basis of the activities and the participation lies on the fundamental notion of the foundations of the reality. The assumed standpoint resides between purely ontological and epistemic perspectives (ref. [248, 52-54]). The reality builds on the ecological change **(4)** of social, cultural and natural practises of the human society and its contexts. It is expected, however, that the ecological change itself accounts as an infrastructure even if it would be somewhat amorphous (ref. [594, 108]). Some aspects of the relativist ecology are in this respect explicable in terms of models and ontological constructs, as the information may (and is occasionally useful to) be treated as if it was a thing (Section 2.4.1).

With the fifth aspect of the information activity **(5)**, the present study does, however, refuse the strict forms of linguistic constructivism and constructionism (ref. [761]). It is assumed that the social world resides not only in a literally understood 'language', communication or information, but also in the organisations, artefacts, economic and ecological structures of the life-world. These structures form together an evolving infrastructure, which gives shape to the perceived reality. The reality is constructed not only in the articulation and communication, but also in the being and interaction of the different actors and infrastructures.

There is no reason to assume that the functioning of these infrastructures or 'systems of being' formed by the physical surroundings, emotions, desires, everyday life activities, social structures or virtual realities (with a reference to the subject of the present study, ref. Chapters 1 and 3) would be directly comparable to the functioning of the 'traditional' expressional systems such as text, image or moving image. The assumption of the present study is that all of these 'systems of being' should be treated in a manner, which does not assume anything of their structure or functioning, which would be based on direct analogous comparisons with an utterly different kind of infrastructure. Emotions function as the emotions do, texts do as the texts and the virtual realities like the virtual realities. Therefore it is quite fundamental to alienate oneself from the information infrastructure under scrutiny to reach a proper understanding of its nature and characteristics.

In conclusion, the most essential contribution of the anthropological point of view may be seen to be its explicit readiness to deal with the preemptive complexity of human information interactions. The complexity is embedded in the contexts of observation, omnipresence of participation and the constant evolution of the so-

cial and cultural phenomena. The fundamental issue of the complexity from the anthropological point of view, is its nature of not representing a complexity of disorganisation, but rather a complexity of incomprehension. If the convolutions were primarily of putting a number of correct puzzle pieces in place, the issues were rather straightforward. The interface between the different contexts is, however, built of an infinite number of incompatible pieces, which makes difficult, not the task of piecing them together, but the task of recognising and understanding them and their meanings.

2.7.2 Context and situation

The anthropological viewpoint underlines the salience of contexts and contextual situatedness. It is rather obvious that information work is related to something and situated somewhere. It is not isolated. The definition and description of this 'non-isolation' is, however, a problematic task. It requires dedicated attention, because the nature of the situatedness is a key to the understanding of the contextual complexity, comprehension and incomprehension between the infrastructures.

The vagueness of terminology seems to have been especially characteristic of the postmodern discussions about the nature of contexts and situations (ref. [227]). Thomas and Nyce discuss the different views of the 'context' in information science. Early studies tended to see it in terms of domain-specific transitions, as some kind of a social situation [770, 106-107]. Context has also been seen as a person-centred phenomenon [839] and as a physical place (i.e. restaurant, library, travel agency etc.) [129]. Chatman referred to the context as a social milieu, social situation and social type [770, 107] in her studies (e.g. [155]) on the human information activity. Taylor has proposed a related concept of *information use environments* to address some of the contextual issues [763]. The examples demonstrate that it has been a prevailing view to keep the contexts as primarily human phenomena. Ingwersen and Järvelin emphasise, however, that also the technical information systems reside in a contextual space [398, 280]. The present study places a special emphasis on this particular notion, which concurs with the idea of augmented participation and actorship discussed in Section 2.7.1.

Chang and Lee emphasise on a basis of a literature review and an empirical study that a context is stratified and dynamic, and it consists of several situations. Each situation is defined by a set of contextual factors. The proposition of Chang and Lee for a new approach to represent contexts and situations argues that multiple relationships of different levels need to be established between a context and an *information behaviour* (the concept, ref. Section 2.7.3). The proposed relationships are an *association relationship* (some types of information behaviour tend to be related to some types of situations; solving a distinct type of a problem usually proceeds in a rather uniform manner), *interaction relationship* (information behaviour changes the situation i.e. article becomes available through a social interaction with colleagues) and a *one-directional relationship* (the social situation i.e. e.g. the general code of conduct affects the information behaviour and makes people do things in some specific manner). According to the model, for instance, the context of a dissertation research constitutes both dynamic situations and multiple contextual factors (type of tasks, problems, and accessibility to information). The factors do not serve only as a backbone of the context, but also characterises the condition of every *situation* [152].

The *situation* may be seen as another dimension of 'non-isolation'. Not unlike

the 'context', the concept has been equally problematic to describe (ref. [818]). Cool [185] presents an illustrative overview of the principal debates on the 'situation' and its varying uses in information science contexts. The most constituent discourses concerning the 'situation' in the context of the present study, are the model of *situated action* developed by Suchman [746][750], the *information environment approach* represented by e.g. Taylor and Algon [763][15][185], the *situated cognition* movement [123][169][170][171][519][518][607] and the *social interaction theory* of Goffman [324]. In this study, the situations are perceived to be environmental, although in an active sense, which contrasts with the information environment approach [763][15][185]. A situation is not merely a scene of an action, but also a trigger and an active participant in all human activity with the other involved actors (i.e. human-beings, instruments, infrastructures, ref. Section 2.7.1).

For the present study, the most constituent aspects of situation incorporate the notions that:

1. Human actors adapt their behaviour according to the cues and elements, which are present in the interaction environment (i.e. according to the situation) [746], and according to the entirety of a behaviour is a sum of their earlier experiences and the divergent characteristics of the present situation [324].

2. All human action take place within social situations [324].

3. Situations are environmental, although in an active sense, contrasting to the information environment approach represented by e.g. Taylor and Algon [15][185]. Situation is not a mere scene for the actions, but a participant in human activity.

4. Human cognition and knowledge are linked with situations and are based on an organisational identity and norms. Situated activity often involves processes of re-conceptualisation of the meanings and objectives [519], and analogically, also of the different values related to human activity.

The present study perceives the contexts and situations basically as separate concepts like Chang and Lee [152], Sonnenwald, Wildemuth and Harmon [707][711], and Ingwersen and Järvelin [398, 278-282] (cf. [155]), although it is argued that a situation may be covered by referring to an appropriate context. The relationship of the two concepts is perceived in a less hierarchical manner than by Chang and Lee [152] or by Sonnenwald [707, 180]. A context does not consist of several situations, but rather involves them. However, as Sonnenwald writes, "a context is somehow larger than a situation" [707, 180]. The current scrutiny is inclined to perceive contexts as 'larger', primarily in the sense of their temporal dimensions and in the scale and scope of their tendency to change and adapt.

Ingwersen and Järvelin have made a related statement that a situation is "at hand" [398, 279] (ref also case 2 in [663]) in contrast to the more long-term contexts. The emphasis of Ingwersen and Järvelin on the "historical contexts" makes a deep analytical sense by underlining the temporal dimension, yet it needs to be stressed that a real distinction between a historical and a 'present' (or a future) context is impossible. The present is as historical as any moment in the past. Due to the temporal variation, it is suggested that a context is easier to observe, but more difficult to manipulate than a situation. Situations are more difficult to foresee, but on the other hand, a situation is easier to trigger and manipulate than a context.

The articulation of the two different levels of 'non-isolation' as contexts and situations is analytically beneficial. A researcher and a developer may use them as conceptual instruments to articulate different contextual characteristics of an information system or a work system and to designate whether any related emerging issues may be addressed by the features of the system, the organisation of the work or its environment (the level of situation), or whether the system requires more profound transformations (the level of context). Furthermore, it is argued that by articulating a trait as belonging to a context, it is possible to acknowledge the constituent nature of that particular trait and to use it as a constraint or affordance in the development of the work process. Basically this implies that the context is the subject of the information work research. The focus of the investigation is to understand and describe the context in order to map the premises of "something" within the scope of that which is understood as the work (following the lines of radical contextualism of Grossberg [338], ref. also [600, 47-54]).

2.7.3 Information behaviour

Apart from being contextual and situated in the framework of work, work roles and information, the information activity is embedded with participating individuals and their personal and contextual ways of acting and behaving with information. Dinka and Lundberg touch upon this double bind by referring to identity and role [232]. The present study discusses the phenomenon from the information point of view by referring to work roles and their related information interactions, and to the information behaviour, which is seen essentially as a manifestation of a personal self identity in terms of information activity.

The notion of *information behaviour* evolved from the paradigmatic change of the general emphasis from the system orientation to the user and usage consciousness in information science and information systems science during the 1970's and the 1980's [587, 43] (ref. also [833][764]). The shift was broadly parallel to the paradigmatic changes denoted as a *cultural turn* in the social and cultural studies, which placed a special emphasis not only on the notion of culture, but also on the human actors, communities and *meanings* (ref. cultural turn and information [815]). A practical motivation for the shift may be traced back to the growing practical difficulties in systems design, which were accentuated by the rapid technological developments and the subsequent increase in the complexity of the systems [557]. Query oriented view of the users, information needs and the matching query results did not provide an adequate model of actions and interactions of the human information activity. At the same time, the possibilities to study information needs were perceived to be problematic. As Wilson pointed out, the studies of human search strategies managed to elaborate more on the information seeking behaviour than on the information needs [833]. Wilson has defined information behaviour as the "totality of human behaviour in relation to the sources and the channels of information, including both active and passive information seeking, and information use" [835, 49]. In spite of the initial critique of the concept "information behaviour" and its appropriateness [587, 44], it has received general acceptance as a term for describing the totality of the human information interactions.[9] The appropriateness of the concept is further underlined by the emergence of several related notions in

[9] The concept of information behaviour has been perhaps even surprisingly characteristic for information science. Some information behaviour related studies have been conducted also in related disciplines such as in psychology, information systems and consumer research [836], but mostly the concept has remained a property of information scientists.

the neighbouring disciplines, including the *knowledge sourcing* in the management sciences [333].

In spite of the popularity of the information behaviour concept and the subsequently notable number of related research (ref. e.g. a recent overview of the different theories [275] and the ARIST review of Case [150]), most of the attempts to model human information behaviour have concentrated on explicating the human information *seeking* behaviour (ref. [663]). Spink and Cole emphasise the important fact that the entirety of the human interactions with information (referred to as information behaviour), is not merely seeking, but is actually composed of additional components such as the organisation and use of the resources. Therefore, it is equally important to discuss the information organising behaviour and the information use behaviour [715]. Spink and Cole present a tentative version of an integrated model of the information behaviour, which combines the three typically used approaches: everyday life information seeking, information foraging and the problem-solution perspective [715].

The perspective of information behaviour adopted in the present study follows the lines of Solomon (based on Dervin) [702][703] and Chatman [154] (ref also [155]) in scrutinising the information activity as a life-world wide phenomenon, which is not confined to any specific information seeking or use situations. It is suggested that the information work is an ubiquitous activity and thus, the related information behaviour is a relevant social, cultural and cognitive framework to discuss the human perspectives of the information related efforts. Information behaviour is not static. It does not begin or end, but rather evolves in time, in changing situations, and in conjunction with the developing means to work with information (technology [61][549], organisation e.g. [243]). There is no single typical information user or behaviour. For example, the scientists seek (and use) information in a different way than the social scientists or humanists do, as Tenopir [766] emphasises. In a comparable manner, the personal preferences and characteristics affect the information seeking and use (according to Heinström's study [362], in a more profound manner than the disciplinary affiliations of students do). The impetus to study information behaviour from a wider perspective coincide well with objectives of Solomon to grasp the information in the life-world context (in the present study in a slightly more limited scope of a specific domain related part of the life-world) and to acknowledge and investigate the role of time in the information behaviour [702][460, 49].

The problematic relation of work and information behaviour was already discussed in section 2.5.2. Leckie and Pettigrew [479], who themselves included the work roles into their general model of information behaviour, observed that roles do not seem to offer a sufficient framework for studying information behaviour. The notion of a work role does provide a satisfactory explication of the objectives of work (a partial answer to the question "why"), but does not address the issue of 'means to reach the goals'. The work roles do however, provide the means to understand and discuss the relations of the information behaviour and the work life on a more general level in order to perceive wider patterns of information work beyond the level of individual tasks and actions. The notion does not undermine the importance of detailed approaches such as a task-level perusal (Section 2.5.1), but merely stresses the importance of a multi-level dissection of the human information behaviour and its convergence with the notion of work.

The systems thinking oriented approach differs from the task-based models in the perception that the use cases (ref. Sections 2.5.2 and 6.1) are composing factors

of the system level information activity, instead of decompositions. Systems thinking does also allow and at the same time presume the perusal, which spans over the entire life-cycle of information. In the assumed approach the focus is not on the information interactions related to the completion of a task or to a group of tasks. The emphasis is on the interactions seen as contributing factors to the functioning of the system, which comprises the work role and its related activities. Byström and Hansen have described a task as a particular 'item of work' with a distinct beginning and an end [138, 1051]. In contrast to this explicit finity, the systemic approach emphasises in particular, the different aspects of the 'items of work', approaching a focus on the notion of shared behaviours, which is necessary in the design of information systems [381].

Compared to the prevailing situation with context and environment aware frameworks of information use (e.g. [763][635][842]), the current approach makes an attempt to define and describe systematically the interplay between the actors and the environment. Furthermore, the viewpoint underlines the constituency of the functioning of the structural surroundings of the information work. It is argued that a mere description and classification of the environment on the level of conceptual models, is not enough (cf. [763][635]). Unlike some traditional systems oriented approaches, the present study does not assume that human activity would be steered by an external system [635]. In contrast the individual actors and all of the involved infrastructures are perceived to form together an instance of a soft system. It is assumed that the information behaviours emerge within the contextual inter-actor system of the information work and are therefore shaped by all of its components: involved actors, situations, and the contexts of activity. In the following section, the situatedness of information behaviour is discussed further with a reference to the notion of the information horizons.

2.7.4 Information horizon and work horizon

Emergence and evolution of a human information behaviour is a complex contextual, situational and social phenomenon. Sonnenwald has addressed this complexity by introducing a theory for structuring the information behaviour. According to Sonnenwald, there is an *information horizon* within the context and situation, where information activity takes place [707, 184-185] (ref. also [711, 68]). Basically an information horizon is a group of available information resources and information about their availability. Information horizons are determined socially and individually. The theory takes into account the interactions between different resources and their directionality by referring to the notion of availability [707].

The methodology of working with the information horizons involves construction of information horizon maps. The maps are graphic representations of the information horizons. Sonnenwald has focussed on using maps drawn by her informants [707](ref. also [711]). Another thinkable alternative, adapted in the present study, is to use analytical maps, which are constructed by the researcher on the basis of empirical material (e.g. interviews or observation). Informant drawn maps are essentially a data collection method, whereas the analytical maps are an analytical tool for explicating the human information behaviour.

Considering the present study, the information horizons theory offers two analytical benefits to the discussion on the information instruments used by the human actors (within the frame of the information behaviour). First, the information horizons approach emphasises the dynamics of the availability of information resources

in a more human oriented manner than the technical considerations of being accessible or being inaccessible. The second important benefit of the information horizons is that the concept places emphasis on the organisation and interrelationships of the individual information sources[10], instead of perceiving them as residing 'in a bag'. Information behaviour is not emerging in an 'information isolation', nor is it driven alone by active or accidental seeking of information. The notion of information horizons effectively organises the instruments of information behaviour. Information horizon is an answer to the questions of "with whom" and "by what" the information work should be accomplished. It refers to the relationships and interactions between the instruments and the information represented in the figure 2.2. Information horizons theory has been applied mostly to the study of information seeking [707][708][711][710], but the notion of an 'information activity related horizon' allows to extend the consideration to grasp also other instances of information interactions such as creation, organisation and use.

Considering the scope of the present study, it is apparent that the notion of information horizon addresses only partially the complex contextual horizon where the work and information work are situated. As it has been already implied, the similar horizon of work is equally essential as the horizon of information sources and artefacts. Therefore, it is considered necessary to introduce an analogous concept of *work horizon* to denote the space where the work activity takes place. Similarly to the information horizon, the work horizon of an individual consists of the available sources and resources of *work*. In a still broader scope, the analogous instruments of human life might be described in the terms of a *life horizon*, which is however, only briefly touched in the present study.

Work horizons may be depicted analogically as work horizon maps, which may be used to illustrate the components and their mutual relations. The work horizon may also be used indirectly to present the multiple analytical dissections of the work and information work, which has been done in the present study. In the case of the current investigation, the new concept becomes applied in a tacit manner. Work horizons manifest and are described in the work roles, CATWOE (**C**lient, **A**ctor, **T**ransformation, **W**eltanschauung i.e. world view, **O**wner and **E**nvironment, ref. Table 6.1) analyses and the use case diagrams. Even though the work horizon itself is not in the focus of the perusal, the concept is necessary in order to be able to understand the mutual dynamics of the work, information work and knowledge organisation.

2.7.5 Beyond the horizon of context and behaviour

A critique of the information behaviour research and the user studies of interactions between humans, computers and information in general, has been frequently pointed towards the primarily descriptive nature of the research results [373][633]. As has bee already discussed in section 2.7.1, notwithstanding the critique, a focussed and intensive investigation of the users has proven to be an effective instrument for explicating the complexities of human activity in several information sciences contexts (e.g. [746][154]). Similarly, the information behaviour has proven to be a usable concept for explicating the issues of human information interaction. In spite of the constantly developing understanding, it has proven to be conspic-

[10]Following the prevailing, although a somewhat imprecise convention, the term 'information source' is used in an inclusive meaning without making a specific distinction between information sources, information resources or information channels.

uously difficult to translate the observations into a theory and subsequently, to a set of functional tools, which would benefit the practical work of designing information systems, classification schemes, user interfaces and information repositories. The essence of the early 1980's critique of the technology orientation of the information research have persisted [837], even though the focus of the interest has somewhat shifted towards the practicability of the results from the plain argumentation of the scientificity of the research procedures.

The poor match may be explained by a number of factors. The fact that the theoretical discourse has shifted its orientation from the systems to the users in information sciences, and further to the cognitive and social processes only within a couple of decades, is clearly symptomatic of the existence and acknowledgement of the fundamental complexities of the human information interaction. It is well-acknowledged that a machine is difficult to match with a human-being and a human-being is equally different from anything static or predefined in the sense of a machine. Nothing seems to be truly generalisable in the information related issues nor preeminently defined in spite of the optimistic hopes expressed in some scholarly contributions (e.g. conclusion in [187]).

The present study considers the view of information related activity as a phenomenon as an essential notion, which is principally unconfined, but still in a constant state of organising itself. A concentration in individual traits or tasks does not take into account the wider context of the information activity. The investigation of individual actors or perspectives produces explanations only in a confined scale. The confined scale leads to accurate observations, but subsequently to designs, which are theoretically ideal, but also unsatisfactory in action and without any practical relevance in their contexts.

The observations, which are made within purposefully limited scopes, are useful and provide accurate results if the defined limits fit well into the wider scope of activity, and the abstraction is carefully constructed to meet its realistic contexts. A need or a task may be an expression of knowledge related motivations (a 'real' motivation even if it is no more 'real' than any other motivation as such) or an external notion i.e. a manifestation of a convention, a representation of an external affordance or abstraction instead of a reason, which may be rationalised by the activity e.g. work or an internal thrust. If an observed trait is essentially external, the observations and consequent designs are bound to be correct according to the heuristics and the requirements analysis, but still lacking practicality. The watershed between the external and internal motives is necessarily vague, but does still serve as a meaningful divide between the close and remote horizons of activity.

The information horizons approach developed by Sonnenwald turns to consider the effects of the watershed and the (practical) confines of the theoretically unconfined space of activity from the information point of view. Even if any connections (associations) are possible, the existence of an information horizon affords certain associations and makes them more probable. This results in an observation that an information horizon is no more a descriptive category or a collection of active information sources [707, 186-187], but an active participant, which deeply affects the functioning of the sphere of information work.

There is an obvious answer, which is, however, difficult to accept. Information work studies are capable of providing useful insights for the developers and designers of the new information and knowledge organisation systems, and management strategies. The studies do not, however, provide clear and definite answers. The ethnomethodologically informed ethnological approach was introduced to ad-

dress this particular issue in the context of ethnographic research. The point is that the an ethnographic inquiry could be applied to provide foundations for an informed design [196]. The basic argument of the approach is that the ethnographic observations have to be consulted and interpreted by a designer. Preferably this consultation could be done in collaboration with the ethnographer, but the central issue is that both the research and the drawing of the conclusions have to be done by an expert. A designer, who is not an ethnographer is not informed enough to conduct a user study. Equally an ethnographer is not automatically a designer and is thus unqualified to tell a designer how and what to design [196].

The approach may be generalised to a proposition that a developer always needs relevant expertise in information work research methods to be competent to draw the appropriate conclusions for an effective and efficient design of information systems and management of information work. The researcher, who will be conducting the user studies ought to be similarly informed of the design basics like the designer should be of research. Finally, the research objectives should be matched with the development objectives. If a research design does not incorporate an orientation towards a distinct practical design and development implications, it is doubtful that there will be any such implications in the findings. The point appears to be a somewhat obvious one, but does in fact contain valid critique of the prevailing implicit shade of positivism concealed in the expectations of how the user studies should inform the design and development activity. A plain study of user behaviour is not fit for providing definite guidelines for the systems design or information organisation, because of the lack of premisory formalism needed in the assignment.

The focal aspect of moving beyond the horizon of information work, information behaviour and information horizon, is the subsequent shift in the mode of interpreting the findings of a user study, whether it is an ethnographic observation or an interview. The entire project of moving the focus of the perusal between the human system and the formal organisation of work and information work, requires sensitivity in the different instances of work (Fig. 2.6), information work and information behaviour within the meta-context of information work. The meta-context is depicted in the figure 2.6. All of the depicted aspects may be and have to be controlled to reach a satisfactory result. The situation is obviously hardest to control. It incorporates most uncertainty. Also the diffidence of a situation is primarily of a momentary kind. Yet the observations of the human behaviour suggest a degree of repetitiveness. Bartlett has conceptualised this observable repetition and organisation of human activity in schemata, which denote "an active organisation of past reactions, or of past experiences, which must always be supposed to be operating in any well-adapted organic response" i.e. a schema [63, 201] (ref. also [152]).

The framework of work and information work applied in the current study is illustrated as a meta-contextual framework (Fig. 2.6). The graphic presentation places emphasis on the active nature of the relations, and on the situatedness of the actors at the moment when the information work instantiates. In the essence, there is never an exact stable moment like the one presented in figure 2.6. All of the components, which are present in the components of the framework, are in an infinite state of alteration. The actor is acting both as such, and within the framework of an assumed work role (or several overlapping work roles). The 'actor' and the 'actor in work role' are inseparable, yet it is assumed that the actor does act and react to the surroundings both as a personal individual and as a participant of the work role (see 2.5.2).

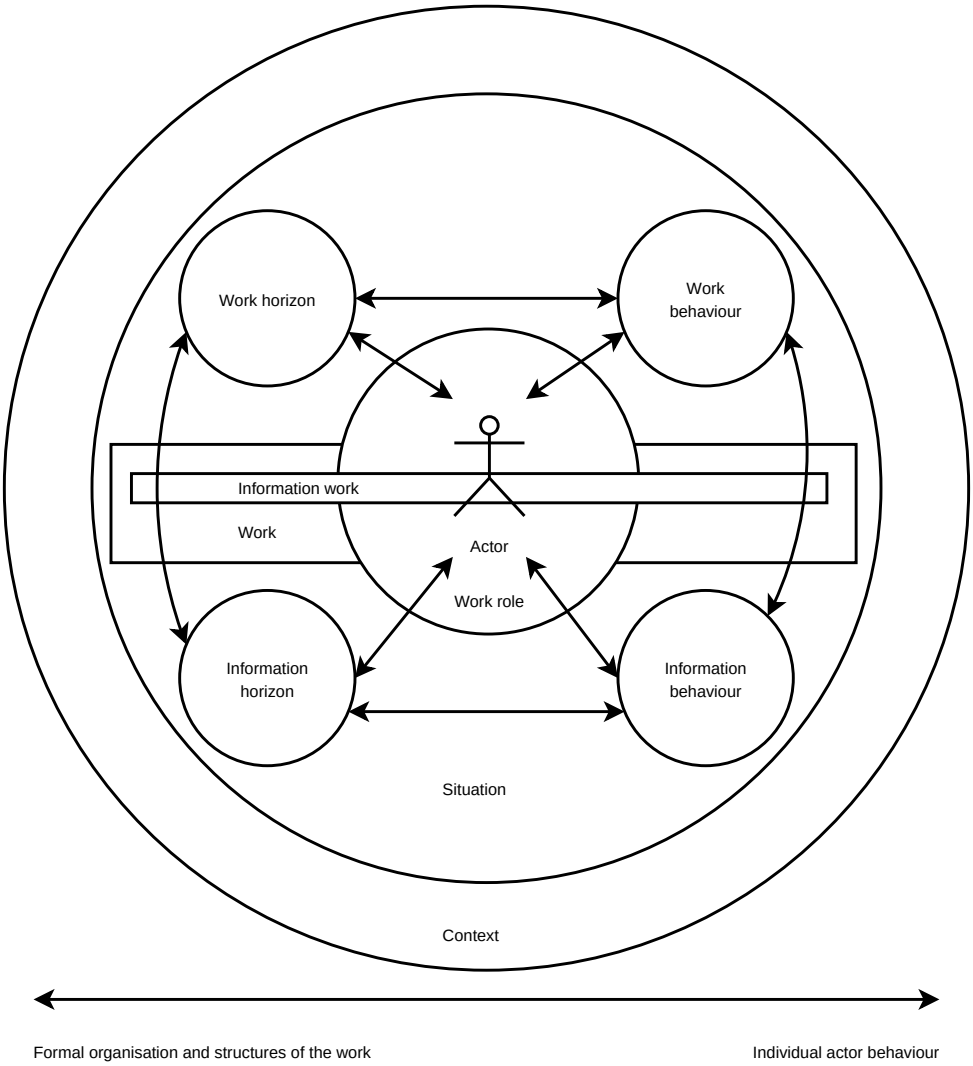


Figure 2.6: Work in context

Besides illustrating the relations, the framework also explicates the focal points of interference for an information specialist and an information systems developer. A system or a scheme of information is capable of begetting change in the whole framework by manipulating the horizons of information and work, by affording and warranting the work and information behaviour, while still maintaining its purposes, meanings and values. The information systems need to follow these purposes, meanings and values of the work i.e. support its principal objectives in the sense suggested by Taylor already in the beginning of the 1980's [764]. Their capability of empowering change is, however, equally important to keep in mind. The present approach is an attempt to grasp in one framework the processual and systemic nature of the work and incorporate the notions of complexity and contextuality (cf. *information fields* in [418]), the need of addressing the change, holism and undirectedness (in the sense of the Sense-Making approach of Dervin [229][226][662]), and the simultaneous need of maintaining working control or 'mastering' (i.e. 'knowing the ropes', ref. [250]) a relevant horizon of information, in one framework. Information work is embedded in an undirected pursuit of managing the personal life-world within the context of the work, and in a directed activity of accomplishing the challenges related directly to the work itself.

2.8 Towards a sociocultural viewpoint: cognitive work analysis and information work analysis

The theoretical framework, which is assumed in the current study, builds extensively on the earlier research. Considering the earlier analytical frameworks, which explicate the relevant issues of human information work, the present study is related most closely to the notion of *cognitive work analysis* [802], even though there are several constituent differences. The differences and similarities are discussed here to summarise and conclude the essential considerations of the framework of the current study.

The cognitive work analysis approach was introduced by Rasmussen et al. and developed in a series of papers from the 1960's onwards as a distinct part of a wider framework known as cognitive systems engineering [609][610]. Cognitive work analysis has been used in information systems science to address such topics as the evaluation and analysis of systems and collaborative work [581][270]. In information science, the principal advocates of the approach have been Fidel and Pejtersen (e.g. [580][271][270][269]).

Cognitive work analysis is a conceptual framework, which is focussed on the notion of work. The approach incorporates the essential ideas of systems thinking, adaptive control systems and the Gibsonian ecological psychology. The explicit aim of the approach is to inform information systems design by first analysing and explicating the existing systems, and then developing recommendations on the basis of the findings. The approach is interested in the work the involved actors do, their information behaviours and the contexts and the reasons of the work in an attempt to reach a holistic understanding of tasks and their surrounding environment. The focus of the analysis is on the contextual constraints [313], which affect the work, and on the information behaviour. Cognitive work analysis addresses the notions of contexts and contextual dimensions, the complexity of the environment and of the individuals, and the need of providing an analytical structure of the real-world phenomena instead of mere descriptions [269]. The analysis is performed simul-

taneously on multiple dimensions. Each dimension is embodying a distinct set of attributes, factors or variables [269].

The cognitive work analysis and the analytical approach of the present study share characteristics and interests. The most constituent one of those is the salience of referring to the work as a useful scope and an instrument of analysis.[11] The two approaches do however, differ in several aspects. The differences underline clearly the emphases the foci of the analytical approach of the current study. First **(1)**, while the basic priority of the cognitive work analysis is to inform information systems design, the information work analysis directs towards the management of information work by providing an indepth understanding of the organisation of knowledge, information and work. Information work analysis assumes that the system in question is an already existing one, complete with its human and non-human actors. The constituent contribution of the analysis is to provide new information about how to manage the entire system of the human life-world. The proposed method focusses on organisation of knowledge and organisational assets. This task may be accomplished by building new information systems (in holistic sense to include intellectual and computerised systems cf. [270]), but essentially it is a question of managing an existing framework, not on developing new ones. This point of view places a special emphasis on the evolutionary, fluid and continuing nature of the human work and existence. It is argued that the purpose of the analysis may not be in developing structures for succouring work, but to enable the work and its infrastructures by effective management and organisation.

Secondly **(2)**, the information work analysis approach is concerned on the information work as a distinct component of work. Information work is deeply embedded in the conventions of the work (discussed in section 2.5.3), but it does still remain as a recognisable entity and a subject of analysis. Even though the information needs and behaviour are closely tied to the process of working, the information work is assumed to be a parallel process, which may take several different directions even if the work itself remains unchanged. For example, the work of preserving cultural heritage assets or even a single task of inspecting an artefact may remain the same on the level of its purposes, values and meanings, while the expected information needs, seeking and use behaviour, i.e. the information work, may take several different directions.

The third difference between the two approaches is **(3)** their relation to the Gibsonian ecological psychology. Cognitive work analysis is focussed on explicating the constraints, i.e. factors, which restrain human information behaviour in each context. Information work analysis does peruse the affordances and constraints of information work behaviour, but is essentially more concerned with the notions of purposes, meanings and values, which manifest themselves in the facets of the information interactions (ref. Section 6.1). The facets are factors, which are perceived to have an influence on the outcomes and the outline of the information activity. The importance of the constraints is acknowledged, but the information work analysis attempts to assume a positive stance to the human work. The most important determinant of work is not related to the limitations of the possibilities, but to the aspiration to achieve something and to the sense of meaning, value and importance of the process.

The fourth and the most constituent difference between the approaches is that **(4)** information work analysis functions on the social, cultural and organisational levels of the work instead of the cognitive. The focus is on explicating how an en-

[11] The notion is shared by all work and information oriented approaches (e.g. [99][100]).

tire organisation might perceive and conceptualise work processes and the different actor roles assumed by its members, as a collective notion. Cognitive work analysis on the other hand, places initial emphasis on individual actors and develops a wider framework in a bottom-up order. The organisational focus of the information work analysis is reflected in the integrity of the notion of the work roles as components of a meta-actor framework.

The strength of the cognitive work analysis is on the accurate perusal of work in its contexts. Propagators of the approach suggest that it permits generalisations by combining the results of multiple analyses, which have been carried out on a same domain. Comparison of the case examples does admit the distinguishing of the patterns [270]. Information work analysis attempts to grasp patterns through studying several individual contexts and individual actors within the framework of a single study. The individual cases are considered carefully to discern patterns between the instances. Information work analysis perceives the individuals as nodes in organisational and domain-wide networks. An individual and her behaviour is assumed to reflect necessarily the constituent patterns of the organisations and subsequently, of the entire domain. The method to grasp the patterns, is to follow the organisations and the domain in an intensive anthropologically and ethnographically informed study of the individuals.

In conclusion, the differences of the cognitive work analysis, and the information work analysis assumed in the present study may be summarised in four points: 1) information work analysis is an information management approach in contrast to being an information systems design approach, 2) information work analysis distinguishes information work as a distinct component of the work, 3) cognitive work analysis is focussed on Gibsonian ecological constraints instead of the explication of the affordances and constraints, and 4) the scope of information work analysis is social, cultural and organisational instead of being cognitive.

2.9 Summary

The chapter discusses the theoretical framework of the study and presents an analytical viewpoint referred to as *information work analysis*. The study examines human activity explicitly from the point of view of the information (Fig. 2.2) adopting a management perspective, which foregrounds the idea of contriving conscious change in work and its infrastructures. Information is seen as a qualitative cultural concept , which manifests as a contextual property, and as a practical matter, which is a part of the everyday life and work.

The landscape of information and work is seen as comprising the element of a human actor, who has assumed one or several work roles. In the present study the concept of work role is used to refer to a distinct set of activities within a 'work' similarly as the 'work' is a distinct set of activities in a broader scope of human life-world. From the information viewpoint, all work comprises processing of information i.e. information work. The precise patterns of information work are dependent on the actor, her personal *information behaviour*, the assumed *work role*, the available information (embodied in her *information horizon*) and the *context* and *situation* of the activity (ref. Fig. 2.6).

The present study emphasises the contextual, situated and evolutionary characteristics of information and human activity. The viewpoint is anthropological and it builds on a sociocultural understanding of the soft systems theory and Gibsonian ecological approach. The rationale of the approach is to be able to focus the

analysis of information interactions on a meaningful level of understanding, where the interactions may be perused in a reasonable level of abstraction, yet retaining at same time a picture of the fundamental purposes, meanings and values, which guide the activity.

Chapter 3

Knowledge organisation and virtual realities

This study perceives virtual realities as infrastructures, which may be used for organising information. It is further proposed that these infrastructures may function in turn as a framework for managing information and information work. The current chapter explicates the theoretical background of using the notions 'virtual' and 'virtual reality' as a conceptual and practical framework for knowledge organisation. The following sections examine the information science notion of *knowledge organisation* and the concepts *virtual* and *virtual reality* from the information point of view. The proposition of integrating knowledge organisation and virtual realities is based on the distinct infrastructural qualities (engagement, interactivity and dimensionality) of the virtual realities and on the implications of these qualities to the organisation of knowledge assets. It is suggested that the success and usability of knowledge organisation is dependent on how well the knowledge assets and the organisation infrastructure converge.

3.1 Knowledge organisation

An initial assumption of the present study is that knowledge may not be managed or organised directly. It is necessary to emphasise, however, that the assumed approach does not signify that the concepts 'knowledge organisation' or 'knowledge management' should be discarded. Even if an entity titled 'knowledge' would not exist as a static and explicit phenomenon, it is suggested that a dynamic and process-like knowledge may still be steered indirectly through controlling a set of impinging assets. The steering is never absolute and the control is not perfect, but a certain degree of conscious influence is assumed to be possible. The following sections present the notion of knowledge organisation, its relation to the concept of information infrastructures and the criteria of organising knowledge. The discussion is concluded by formulating an ecological viewpoint to the theory and practise of knowledge organisation.

3.1.1 What is knowledge organisation?

Knowledge organisation (KO) has been a prominent research topic in the information and documentation studies for some decades (e.g. [230]). The traditional

focus of the investigation has been on enabling efficient retrieval by developing indexing and classification of information resources. The theoretical foundations of this principally rather practical topic may be found in diverse traditions. Those include taxonomy, epistemology, ontology, semiotics and theoretical linguistics. The accelerating shift towards ICT-based knowledge organisation systems has turned the researchers' attention increasingly towards the computer related topics such as database theory, data structures, automatic indexing algorithms and the Semantic Web [644, 24][378][93].

As a whole, knowledge organisation may be described as a process of identifying and subsequently describing objects of knowledge dissemination, their content, features and meaning. The discovered identifications and descriptions are thereafter organised in indexes, catalogues and other organisational frameworks, which are denoted in the present context as *knowledge organisation systems* (KOS).

Besides the colloquial notion of 'factual information' or 'data', the knowledge organisation research has become aware of the importance of the social dimensions of information, feelings, emotions and desires [25, 471]. The knowledge resources and the type of knowledge are not restricted to any specific forms of documents or artefacts. Knowledge organisation is not media dependent. Instead, it touches upon every form and format of a message, text and a document, including, for instance, the visual images and three dimensional objects. Similarly, all media from clay tablets to the digital records, including various combinations of different media, are within the interest of the knowledge organisation [25, 472].

Considering the subjectivist definition of knowledge (as something, which may not be organised directly, ref. Section 2.4.2, also [25, 471]) assumed in this study, the term 'knowledge organisation' appears somewhat misleading. According to this interpretation, as Anderson [25, 471] points out, a topic, which is literally titled as 'knowledge organisation' would be within the scope of cognitive science, whereas the field, which is known as knowledge organisation within the information science, is rather a shortened form of 'knowledge resources organisation' or 'knowledge representations organisation' [25, 471]. However, even this precision of definition might not be enough. Hjørland argues for the preference of 'knowledge claims' instead of 'knowledge resources'. The proposal is plausible and does indeed further de-emphasise the remaining positivist shades of the term 'knowledge resources', which bears a slight implication that knowledge might be shared and distributed as a commodity [377]. However, even though the KO is terminologically problematic, historical reasons do present a rationale not to abandon it. Another motivation for preserving it in colloquial use is that the knowledge *is* affected in an indirect manner (if not exactly organised) during the process of managing knowledge related resources or claims. These resources and claims are not knowledge *per se*, but they are capable of causing changes in a state of knowledge.

Basically any system, which is capable of processing and storing knowledge claims or resources according to a *system*, which is based on an explicit principle, may be denoted as a knowledge organisation system. A 'bag of knowledge' may be argued to be such a system in a sense that in the bag, the knowledge claims are organised according to a principle of randomness. A pragmatic, instead of a purely theoretical approach suggests, however, some practical limitations to the acceptable principles. A subject database, citation index, dictionary and an encyclopaedia have been suggested to be different kinds of knowledge organisation systems, which all share the common principle of presenting knowledge resources in an order, which *facilitates their use* [378].

The inclusive, but practical notion of knowledge organisation provides an important hold for the present study. Building on an embracing viewpoint of knowledge organisation and knowledge organisation systems, it is suggested that any notion, inclusive a 'virtual reality', may be considered to be a distinct type of knowledge organisation system. The only condition is that the notion needs to be definable in terms of being a system for processing and storing knowledge resources, which is based on an explicit principle *and* that the resulting system has a *purpose*.

Without at this point making an explicit reference to what a 'virtual reality' is, it may be assumed to be a distinct kind of knowledge organisation system (for a comprehensive discussion on the subject, ref. Sections 3.2.2 and 3.2.3.3) if the condition of principled organisation, processing and storage of knowledge claims is met. The knowledge claims need not to be organised according to the alphabetical order, but according to any suitable principle, which is supported by the structure and ecology of a 'virtually real' infrastructure. Even though the virtual realities may be expected to present a distinct framework for information activity and organisation, their use may be assumed to affect very similar issues of knowledge organisation, which are common with the more traditional systems. In a virtual reality, knowledge claims may be expressed in diverse, partly non-traditional forms and formats, but they are still distinctly identifiable as claims. The claims would be organised according to an existing principle and the systems would be built to be used to empower some information work. A consequential challenge, which emerges from this standpoint, is the issue of how to identify and describe information resources and processes within the framework (e.g. virtual reality) in a manner, which is capable of enabling the tasks of management, retrieval and use. It is suggested that this challenge may be met by explicating and subsequently exploiting the interface between the knowledge organisation system and its conceivable uses.

3.1.2 Knowledge organisation systems as explicit information infrastructures

Information infrastructures and knowledge organisation systems are two distinct, yet intricately related concepts. Whereas the knowledge organisation system is a fundamentally information science related concept, the infrastructures have been referred to both explicitly and implicitly in a more extensive manner in the ethnographically oriented information systems research. Information infrastructure is a broader concept than 'knowledge organisation system'. An infrastructure is a carrier and a premiss for the existence and movements of information and knowledge between individuals, groups and organisations. In a general sense, the term has been used of the world wide computerised information networks [103], of the entirety of the commonly available information repositories [801], and of the cyberspace communities, multi-user dungeons, and comparable structural premises for information interactions [720].

The present study perceives an information infrastructure as a subsurface fabric formed by available information resources and their organisation at a given instance. An information infrastructure is established by its use and usability for the purposes of communicating information. Information infrastructures are the tools, words, categories and information processing procedures for the information work [721], whereas a knowledge organisation system is a systematic and confined representation. Unlike an information infrastructure, it is never an open uncontrolled milieu (ref. Section 3.1.1).

In this study, the knowledge organisations systems are seen as attempts to control and to make information infrastructures explicit and visible. The view diverges slightly from the proposition of Bowker and Star to perceive classificatory schemes as instances of infrastructures [112] (ref. also [408][407]). In the context of the current study, the classificatory schemes, as well as the other knowledge organisation systems, are considered to be *infrastructural candidates* (i.e. potential infrastructures), which are imposed on the existing infrastructures in order to make them explicit. They are controlled and controlling instruments of management with an explicit goal to resist the ninth characteristic of infrastructures (ref. Section 2.6.2), the notion that infrastructures may never be changed from above.

The present study is explicitly about the notions of information work and knowledge organisation. Its emphasis is on an assumption that information is organisable to a degree, either in a direct or in an indirect manner. In this respect, an instance of knowledge organisation is perceived in a broad infrastructural perspective. As the notion of knowledge organisation presumes, it is assumed that the information always needs to be organised according to some principle to form a knowledge organisation system. From the infrastructural vantage point it is argued that the principle merely needs to exist. It does not need to be explicit or directly explicable. In that respect the act of constructing a knowledge organisation system is not an act of bringing order to an in-orderly information infrastructure, but a conditional act of interpreting the existing order, which is complemented by a compulsory act of explicating the organisation in terms of an outspoken principle.

3.1.3 Criteria of knowledge organisation

The explicit principle, which constitutes a knowledge organisation, is not a monolithic entity, but an assemblage of more or less explicit forms of *criteria*. The principle (e.g. alphabetical order) collects the individual criteria (b comes after a, c comes after b etc.) together and constitutes an orderly compilation. A radical empiricist would claim that the only applicable criteria is the correct or the natural organisation of things [380, 149]. In contrast to the claims of empiricism, the subjectivist understanding of the knowledge assumed in the present study makes the knowledge organisation systems fundamentally artificial constructions. Determination of the organisation criteria is thus a result of a subjective choice, not of a straightforward observation.

Even though this standpoint basically denies the possibility of an objective basis of the knowledge organisation, the reaching of a functional and especially shareable organisation scheme requires some rationalisation in the form of shared criteria. In an ideal sense it might be possible to argue that a knowledge organisation system should be based on consensual assumptions on workable knowledge structures. Bliss writes about one possible view of the shared assumptions as a 'scientific and educational consensus' [98, 42-43]. He argues that a consensus may exist, the consensus do validate classifications [98, 138] and a well defined classification would make the consensus more dominant and permanent [98, 37]. The absoluteness of the argument is easy to criticise by using counter-empiricist claims, but the broad objective of reaching a pragmatic agreement, instead of an absolute one, is durable. Therefore, it is argued that in context, it is possible to attain a tentative agreement of criteria, which is based on the documented knowledge claims, and most importantly, which *works* in practise.

The present study uses *domain analysis* as an analytical basis for explicating in-

formation about the prospective criteria of knowledge organisation. Domain analysis has been defined as "the process of identifying and organising knowledge about some class of problems – the problem domain – to support the description and solution of these problems" ([31] cited by [79]), although it is somewhat difficult to maintain that a uniform information science specific form of domain analysis would exist (cf. [376] with [79] and [551][552]). Domain analytical and work domain analytical approaches have been used in slightly varying meanings also within the neighbouring fields of study, such as in the software systems design and in ergonomics [597][347] (ref. also [376, 448-450]). In this study, the domain analysis is used as an instrumental to establish rich descriptions of specific frameworks of information processes (in the present study, archaeology), which are thereafter discussed with a special reference to the virtual realities.

The presently chosen approach agrees with the essentials of the critique of the limited implication potential of purely descriptive user-based investigations (e.g. [834][376]),[1] even though its technical method of gathering research material is based on an intensive user study (described in Part II). Unlike a diametrically user-based standpoint, the current study perceives users as experts and theorists of their work domain [224, 733], but it does also emphasise the active role of information and information activity (Bates [65] cited and agreed by Hjørland [376, 432], ref. also Section 9.1). The premises of knowledge organisation are constructed on this understanding of the practical and conceptualised work domain and on the formal knowledge of the researcher of the applicable information management and knowledge organisation strategies.

Beghtol made a critical observation on the prevalence of the qualitative studies in domain analysis and urged for quantitative investigations [79, 30]. The complexities, which relate to the qualitative methods and the difficulties of reaching definite meta-domain information in the domain studies, are acknowledged. Yet, the current enquiry insists on the applicability of a qualitative user-based domain study. As Beghtol herself notes, there is a clear shortage of solid quantitative methods, and of a theoretical rationale for such methods [79, 30]. Furthermore, the approaches applied in the available contributions including the ones of Beghtol's, are not well fitted to the fields such as archaeology, where there is a shortage of readily computable resources, which might form a basis for even limited quantitative surveys.

3.1.4 Against the rigidity of criteria: warrants and hospitality

The previous section concluded that reaching a satisfactory criteria of knowledge organisation is a complex process, which requires deep analytical understanding of the knowledge domain. Besides this observation, the concept of 'criteria' itself requires further dissection. Even if a knowledge organisation system would be firmly grounded on an in-depth understanding of a domain, there is very little direct causality between the knowledge and an artificial organisation structure. Knowledge organisation is a consensus between practises of work and at best an optimal, but not perfect, structure of organisation. The organisation is rather supported and vouched workable by a 'bondsman' than causally determined by a cri-

[1] Hjørland argues that empirical user studies may represent an important approach, but they should be combined with bibliometrical studies, epistemological and critical studies and studies of the structures and institutions of scientific communication [376, 432]. The notion might well be seen from an opposite direction as an explicit need to complement the aforementioned studies with empirical user studies, which is a standpoint represented by the current effort.

terion. To reflect the nature of its foundations, the bond between the knowledge organisation and its premises, is discussed by referring to the concepts of the 'warrants' and 'hospitality'. Later, the determination of the operational framework of organising knowledge, is discussed in a similar sense by referring to *ecological approach*.

Hulme introduced the concept of a 'literary warrant', which expounded on a principle that the criteria of organising knowledge in any particular manner, have to be present in the literature. Thereafter the notion of the literary warrant has become focal in the discussion on knowledge organisation [287][632][79] although the precise view on its essential meaning has varied from one author to another [78].

In spite of some warranted (sic!) critique, the concept of 'warrant' has been adopted widely as a practicable concept to denote the intellectual criteria of knowledge organisation [755, 72-73]. To replenish the approach, the scholarly discourse has assumed several complementary warrants such as *user warrant, logical warrant* [287], *phenomenological warrant* [808] and *cultural warrant* [78]. The various warrants raise an immediate question on their respective interrelations and how it might be possible to found a single knowledge organisation scheme on multiple warrants. Combining the different warrants is not straightforward. Svanberg points out, however, that the diverging warrants may be used to complement each other [755, 68].

The constituent benefit of using the warrants as a theoretical framework for discussing the premises of knowledge organisation, is the possibility to explicate the existing forcing criteria. They may function both as analytical tools and as a framework for design. The most critical issue to bear in mind is that the warrants do co-exist and some of them might even be contrary to each other. Beghtol introduced the concept of *hospitality* to address the issue of the co-existence of the warrants. Hospitality refers to the ability of a knowledge organisation system to incorporate new concepts and to found new semantic and syntactic relationships between the existing and the new structures [80]. In this study, the concept is used in a broader meaning to denote an ability to incorporate both intra and inter warrant differences i.e. eventual changes within and between individual warrants. A hospitable knowledge organisation system is aware of them and is prepared to cope with them in an efficient and, in a sense, 'respectful' manner.

The basic assumption is that the various kinds of knowledge systems, actors and knowledge claims are likely to become warranted by diverse justifications. Knowledge organisation schemes may be warranted by individuals and groups of individuals, the literature or by a cultural contract. It is argued that as the criteria of knowledge organisation, the warrants emerge from the factors, which determine the purposes, meanings and values of the work supposed to be supported by the knowledge organisation system. In scholarly contexts, the literature often forms the 'basis' as well as the warrants of new knowledge. In everyday life contexts, the warrants of knowledge organisation and simultaneously the organisatory fundaments of the information activity and information work might be expected to be more dependent on the functioning of the social milieu and the context of the work. What remains to be explicated in the present study, are the premises of how the warrants do emerge and what are the factors, which affect the act of their emergence.

3.1.5 From the criteria to the ecology of knowledge organisation

Besides the classification criteria, another relevant issue of knowledge organisation is the determination of the possible and probable matches between knowledge claims and appropriate structures for their representation. The purpose of the earlier discussion on the warrants was to discuss how the knowledge organisation systems are grounded by some explicable criteria. Simultaneously as being warranted, the knowledge organisation systems have consequences within their contexts. They shape the users' or participants' world view and information work by empowering and suspending the likelihood of the emergence of certain knowledge claims. Determination of the likelihood for an emergence of these matches between knowledge structures and knowledge claims, is perused here by using the concepts 'ecological constraints' and 'affordances' (ref. Section 2.6.5, [312]) as a frame of reference. The approach is influenced by the discussion of Bowker and Star on the ecological and infrastructural characteristics of classifications [112].

The relevance of the ecological approach for the knowledge organisation lies in the possibility to examine the knowledge formation and the processes of organising and using knowledge as interlinked and contextually anchored projects, instead of seeing them as series of actions related to a 'thing' called 'knowledge' or a 'knowledge claim'. A knowledge organisation system is embedded as an infrastructure in a common system with the activities of information work and work. Knowledge organisation should be included to the general system of work, in a similar manner than Eriksson and Nurminen argue that a computerised information system is an inherent part of the work of the users [256].

As already noted, the practical emergence of an affordance requires shared understanding of the environment. Affordances and constraints are based on the knowledge, but they are also its relayers. The basic argument of the present study on the knowledge organisation, which subscribes to the ecological approach, is that the knowledge claims are at the present potential, but in a sense non-actual, or *virtual*, (ref. Section 3.2.1) objects, which generate relationships that closely resemble ecological affordances and constraints. The relations are political in a sense that they have implications on the emergence of data, information and knowledge claims. The topic has been discussed by Introna and Nissenbaum, who write about search engines and how their tendency to include and exclude information has far-reaching effects on the representativeness of the corpus of retrievable and retrieved information depending on the assumed indexing patterns [405]. The conclusion is that the information and knowledge organisation systems possess a capacity to promote, either explicitly or implicitly, some information to become more prominent than some other. The functional characteristics of the system and the chosen practises of knowledge organisation steer the outcome of queries and ultimately, the information provided by the system.

Beyond the non-actuality or virtuality of the knowledge claims, it is further suggested that a knowledge organisation system constructs a distinct set of ecological affordances and constraints beyond the original knowledge claims. In this perspective, a knowledge organisation system is not as much a system of organising objects titled as knowledge claims, but a system of constructing an environment of affordances and constraints, which is usable in warranted knowledge formation.

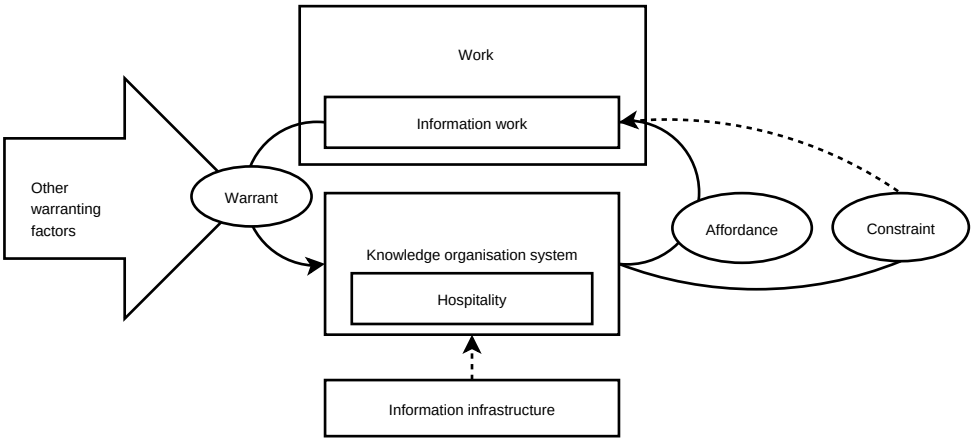


Figure 3.1: Ecology and warrants of information work and knowledge organisation

3.1.6 Bridging knowledge organisation and information work: an ecological viewpoint

Knowledge organisation systems and the systems of information work are perceived in the present study to constitute a meta-system, which incorporates infrastructures, knowledge organisation and information activities. Knowledge organisation system is an instance of an information infrastructure and an attempt to control and to make the infrastructure explicit. The knowledge organisation system itself is simultaneously warranted by its underlying information work through certain distinguishable warrants, which are based on the functioning of the components of the knowledge organisation systems.

Simultaneously to being warranted by information work, the knowledge organisation is bound to shape it according to the ecology of the entire system. An individual system of organising knowledge affords certain aspects and instances of information work and constrains others, forming eventually a circular system of warrants, affordances and constraints (Fig. 3.1). The interrelationship of knowledge organisation, infrastructures, warrants and ecological affordances and constraints is illustrated in the figure 3.1.

The point of the figure 3.1 is to explicate the ecological bonds between the information and the knowledge organisation systems, and the influence of the intrinsic and extrinsic warrants, affordances and constraints to the system. The system establishes the horizons of work and information for its participants. The illustration demonstrates a perspective to the interconnection of the knowledge organisation and information work, and illustrates the cycle, which makes these two information systems relevant to be discussed together.

3.2 Virtual and the virtual reality

Virtual reality is still largely a promise. Technically, the virtual realities are achievable only to a degree. As a cultural concept, the 'virtual reality' is loaded with sharply diverging expectations, values and meanings. As Ryan observes, the virtual reality has appeared in the discussions as a practical tool, a hoax, a utopia or a dystopia:

> "We may have to wait until the new century reaches adulthood to see whether these promises and threats will materialize. But since the idea of VR is very much a part of our cultural landscape, we don't have to wait that long to explore the perspectives it opens on representation. Approaching VR as a semiotic phenomenon, I propose in this book to rethink textuality, mimesis, narrativity, literary theory, and the cognitive processing of texts in the light of the new modes of artistic world construction that have been made possible by recent developments in electronic technology" [650, 18].

The following sections discuss the concepts of *virtual* and *virtual reality*, delineate their constituent aspects from the information point of view and establish a congruent, information oriented, conception of the notions for the purposes of the present study.

3.2.1 Virtual

Virtual is no less ambiguous a concept than the knowledge or the information. The ambiguity of the virtual is well reflected in the number of the proposed descriptions and definitions [634]. Besides the variety of views expressed in the academic debate, the virtual has become even to a greater extent, a common, but ambiguous buzzword of the popular discourse. The virtuality has become to refer to the social forms, where people do not have to stay, encounter, or work face to face with others in order to create products or maintain social relationships [396, 9-10][650, 10][634]. Typically, the virtual is something imaginary [650, 12], yet in its most blurred meaning the term has been reduced to a somewhat negative synonym of something, which involves computing [650, 12, 25-26][695]. Virtual is used as a conspicuously effective marketing term [687, 19] and it seems to have been coupled with almost any noun from a map to a vacation. It summons up countless commercial results on the popular search engines of the World Wide Web [650, 25] if it is combined with practically any other common term

Besides the connotation of 'digital', the virtual bears, both historically and in the present, a suggestion of an 'absence' [687, 19]. The notion of absence is most evident in the expressions, which contradict the existence and nonexistence. Things are often referred either as real or as virtually real [695][687, 19], which carries a superficial suggestion of the state of their being. In practise, the notion of virtual does, however, seem to relate only seldom to the reality of existence. As Shields argues, juxtaposing the virtual and the real is missing some of the point. The frequent use of the concept virtual to denote replicas of the real-world environments, artificial spaces of interaction and digital tools for addressing the physical world issues, does quite to the contrary, portray the virtual as definitely real [687, 19].

Ryan [650, 13] suggests that the virtual appears in the professional and colloquial discussions in **three distinct senses** :

1. **Optical**, which perceives virtual as an illusion.
2. **Scholastic**, which considers virtual as potentiality.
3. **Information technological**, which sees virtual as 'computer-mediated'.

The three senses are expressing a distinct polarisation of opinions between the commonly perceived meanings of the concept. In the information technological sense,

virtuality may be considered essentially as a metaphor, which is used in an attempt to reflect the role of the ICT in the present society. There is a profound distinction, however, between the two senses of the virtual as a potential (non-actual) or as a fake (in another meaning of non-actual) [695]. Within the scholarly community, a fundamental discussion on the nature of the virtual is found, for instance, in Bergson, Deleuze, Baudrillard and Lévy. The first three represent a potentialistic direction, even though their respective concepts of virtual do vary, as Shields observes [687, 26-32], while Baudrillard distinguishes the virtual as unreal, making it to represent a virtuality in an 'optical' sense (ref. the categories of Ryan above on the preceding page). For Baudrillard, virtuality is not merely a state of unreality. Virtualisation bears a strong negative sense of a loss of the reality in the contemporary society. For Baudrillard, instead of being a resource, the virtual is rather a threat to the human societies [71][72, 23][650, 27-35].[2]

The second sense of virtuality (ref. pp. 63), represented by Lévy [487], appears as a more relevant notion than the other two. If the virtual objects and subjects were bound to be unreal, the virtual would remain a rather one-dimensional quality of information. The notion of actuality does, on the other hand, accentuate its contextual and situational positioning.

The non-actual virtuality does also afford some more complex explications of the nature of the information, than the binary notion of reality and unreality. In the field of archaeological computing, Lock assumes a position on the 'virtuality' of the future of archaeology, which is essentially a middle position between the three senses of Ryan (ref. on the previous page), while it remains tightly anchored to the emergence of the information and communication technology. Lock discusses briefly the issues of the emergence of the new identities and the communicative patterns in the virtual milieus, but addresses them essentially in a rather abstract manner instead of discussing their profound practical implications to the archaeological information [494, 253-268].

The *Qu'est-ce que le virtuel* ("Becoming Virtual" in the English translation by Robert Bononno) of Lévy was not the first instance of referring to virtuality as potentiality or non-actuality. A dictionary definition for the virtual recalls the twofold connotations of the term and incorporates the aspects of a 'virtue', and 'possibility' versus a 'definite and thorough presence' [692, "virtual"]: "[t]hat is so in essence or effect, although not formally or actually; admitting of being called by the name so far as the effect or result is concerned" [692, "virtual" (4a)]. In the treatise of Lévy, which is inspired by the writings of Deleuze, the virtual has no direct relationship to the real [487, 13]. He contrasts two conceptual pairs: 1) a static one, which involves the possible and the real, and 2) a dynamic one, which interfaces the actual with the virtual. For Lévy, the possible is something, which does already exists in a nowhere place and, according to a modal logic, is capable of becoming real by removing the logical indication of possibility from the proposition. Similarly, a realised proposition may be turned back to a possibility by the reverse modal operation. Turning a rain-shower from a possibility to a reality requires merely a logical operation of removing the possibility operator in front of the proposition "It is raining".

Virtual/actual relation involves another, more complex, transformation than the logical operation, which turns virtual to actual, and vice versa. It is this transformation, which makes the conceptual interference between the actual and the virtual dynamic. Virtual is not here at this precise point of the time and space, although

[2] In Baudrillardian sense the virtual is comparable to the *anomie* of Durkheim [252] (ref. also [634]).

it is definitely as real as any physical entity [687, 25]. Ryan [650, 36] presents the following characterisation of the 'virtual' of Lévy:

1. "The virtual to actual relation is one-to-many." The number of possible actualisations of a virtual entity is not limited, i.e. virtual may actualise in unlimited instances.

2. "The passage from the virtual to the actual involves transformation and is therefore irreversible" (in contrast to the possible – real relation). Lévy formulates that "l'actualisation est un événement, au sens fort du term" (actualisation is an event, in the strong sense of the term) [487, 135]. It implies the production of novel qualities and has similar implications to the virtual as well [487, 15].

3. "The virtual is not anchored in space and time." Actualisation is the passage from a state of timelessness and deterritorialisation to an existence rooted in here and now. It is an event of contextualisation. Actualisation denotes the introduction of a concrete solution to a problem, while virtualisation is a return from solution to the primordial issue.

4. "The virtual is an inexhaustible resource. Using it does not lead to its depletion."

As Ryan observes [650, 37], the Lévyan concept of virtual may be criticised of renaming the abstraction and generalisation. The concept of virtual does, as she notes, involve a potential to explicate their functioning. For Lévy, the process of becoming virtual is not an alarming withdrawal from the real, but a strengthening of the interaction and awareness between the actual and the virtual. Lévy presents multiple examples of the virtualisation in the contemporary society and culture [487, 25-65]. Ryan extends the list by explicating the virtual properties of art [650, 13].

In an information science sense, the most important virtual resource is the information itself. Information is capable of causing an unlimited number of meanings and values. It is capable of providing means to address indefinite problems and of directly affecting the human society by intervening the lives of the people in multiple manners. The actualisation of information affects directly the organisational economics and productivity. It is capable of creating wealth and addressing social and societal issues. It is not depleted and its practicability is not anchored in any individual moment of time or space. Considering the multidimensional structures, the notion of virtual becomes even more important, because of its special focus and acknowledgement of increasing complexity.

Assuming a post-positivist stance, it is evident that a precise measurement of the degree of virtuality, is bound to be impossible. Inspecting the virtual by using absence as a measure of actuality of information infrastructures and their individual nodes is, however, suggested to be a functional instrument for positioning the virtual in various contexts and rendering visible the different constituent factors of the information work. Absence may be used to indicate the complex multi-valued distance between an information entity manifested in a virtual reality, and its applications in the actual. In simple terms, the absence may provide an answer to the question, how virtual something is, and how little it is actual, i.e. related to the present context of work and information work.

From the viewpoint of the present study, the constituent aspects of the virtual may be summarised in four notions: *non-actuality*, *absence*, *virtue* and *non-autonomy:*

1. **Non-actuality***:* Virtual is real, but not actual at any precise location of existence.

2. **Absence**: Related to the notion of possibility, the virtual is not precisely here at this moment. It is independent of the time and space.

3. **Virtue**: Virtual is perceived as a meta-level entity in contrast to the non-virtual entities ([487, 13-14] cf. with [71][72]).

4. **Non-autonomy of the virtual**: Virtual is something, which is reflected through its actualisations. Virtual is always related (i.e. not autonomous) to these actual entities although not necessarily in a closely resembling manner.

3.2.2 Virtual reality (VR)

The present study assumes a broad understanding of the 'virtual reality' as a computer generated presentation or simulation of an environment where users may interact and experience a sense of phenomenological presence and immersion [687, 54][591, 11] (also [650, 12]). The basic assumption is that the virtual realities are multidimensional. Theoretically the number of the dimensions does not need to be constrained, but in practise, at the minimum three (e.g. in [128, 62] or more (i.e. n-dimensional) dimensions provide an adequate level of sophistication for a meaningful discussion. A one to two dimensional presentation (e.g. a point, 2D drawing, simple statement) is argued to be too incomplex to be able to characterise the special aspects of something being a 'virtual reality'.

Forte summarises the technological expectations placed on a contemporary virtual reality system as a capability of providing inclusiveness (immersion), interaction, real-time interaction and three-dimensionality [282] (similar propositions e.g. [406]). Assuming an information viewpoint, the virtual realities are perused here as knowledge repositories and figuratively as 'a way of integrating the man with the information'. The latter notion was phrased by Warwick [811], however, without an explicit reference to the practical implications of the proposition. The following sections discuss the emergence of virtual realities and the essential aspects of the concept 'virtual reality'. The discussion is concluded by an overview of the theoretical and practical implications of the concept. The purpose of the discussion is to establish an information viewpoint to the virtual realities by considering them as a specialised form of a knowledge organisation system.

3.2.2.1 The becoming of the virtual reality

Even though the origins of the virtual realities may be traced back to the Antiquity and Renaissance [331], the concept itself is less than two decades old [440]. A typical contemporary perception of a virtual reality incorporates a notion of its computer-based nature, besides the basically *atechnological* notions of interactivity, multidimensional graphics and the sometimes more or less implicit expectation of some kind of an immersion [267, ch. 2.1.][734, 5][650, 25][687, 54-55]. The prevalence of this general idea was clearly visible also in the empirical material gathered during the present investigation (Section 8.6).

The physical setting of a virtual reality as a computer generated graphic space was introduced before the virtual reality itself. In 1965 Sutherland [754] laid out a vision of an ultimate display. The display was described as a window to a virtual world where a user can directly manipulate realistically moving objects, which

sound and feel real. The immersion was to be accomplished by using a head-mounted display (HMD) [121]. Another frequently cited pioneer, Krueger, has been experimenting since 1969 with several prototypes including virtual reality rooms and implementations of unencumbered full-body participation. Krueger introduced a term *artificial reality* in 1973, to describe his view of an ultimate computer generated environment [782]. It was essentially similar to the popular understanding of the more recent concept of virtual reality. Following his original idea, Krueger considers physical participation and the indistinguishability from real experience as the key characteristics of the virtual realities [782].

Besides the early practitioners, another influential figure in the development of the concept 'virtual reality' is the author William Gibson. The novel *Neuromancer*, which was published in 1984, presented a vision of the Matrix. It is a mixed dystopian and utopian cyberspace, which forms a global and graphic Internet-like virtual reality network:

> "The matrix has its roots in primitive arcade games," said the voice-over, "in early graphics programs and military experimentation with cranial lacks." On the Sony, a two-dimensional space war faded behind a forest of mathematically generated ferns, demonstrating the spatial possibilities of logarithmic spirals: cold blue military footage burned through, lab animals wired into test systems, helmets feeding into fire control circuits of tanks and war planes. "Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts . . . A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the non-space of the mind, clusters and constellations of data [314, 51].

The Gibsonian idea of the virtual realities reflect the visionary propositions of the virtual reality pioneers such as Kruger and Lanier. Gibsonian cyberspace[3] is still, in a sense, a culmination of what a virtual reality might be.

The precise sense of the term virtual reality depends substantially on the place of emphasis. Underlining the virtual distances a virtual reality from the everyday life reality. Accentuating the reality directs to perceive a virtual reality as a close parallel to that what is already existing. Technically speaking, the making of a virtual reality is primarily a task of providing means to accomplish a reality that might be. Culturally and societally the virtual reality becomes a fundamental question of the human nature. What a human is in a virtual reality and what a virtual reality would do to us.

Many writers, including Baudrillard [71][72], have expressed concern about its causing potential loss of real, immediate, natural and authentic elements in the human experience. Eventually the virtual realities might lead to a replacement of the real with hyperreal [695]. An obvious source of criticism in the dystopian notions, is the obscurity of the mechanisms of the virtualisation in comparison to other social, cultural and natural transformations of the human realities. As Sismondo underlines, the realities may coexist, even if they are bound to be related to each other [695]. Thus, a virtual reality is capable of affecting all the other realities, both virtual and actual, physical and immaterial, but it seems hardly possible that

[3]Besides the later domination of the concept 'virtual reality' also the 'cyberspace' has lived on after the Neuromancer, especially in the cultural studies and media philosophy (e.g. [488]).

any single notion of virtuality or virtual reality might be capable of substituting everything, which is not virtual.

3.2.2.2 Applications of the virtual reality

In spite of the apparent theoretical and technical problems concerning the virtual realities, a diversity of practical implementations of the concept have been tested and put into use in various fields since the 1970's. Internet-based communities such the AlphaWorld [6], military simulators, [538][126], product development [569], health care [533][757][674], architectural [674] and archaeological walkthroughs and simulations [56] have attained definite success in many instances.

The scope of the virtual reality related activity has expanded since the end of the 1990's, but there seems to be still a general tendency that the promising prototypes do only seldom turn into comprehensive and large-scale implementations (e.g. [121][831]). The key problems lay in the area of technological lacking, but Brooks [121] notes also a number of issues, which relate to the various management aspects. The effectivity of interaction (in the sense of manipulation), and the enhancement of travelling and wayfinding are major non-technical issues similarly to the efficient production of models, the measurement of the experience of 'presence' and the practical effectiveness of 'presencing' (i.e. evoking presence, for the concept ref. Section 3.2.2.4). The mentioned issues may, and should, be attempted to be addressed by technological solutions as far as possible, but their inherent cultural nature makes them extremely difficult to manage, or even unmanageable, by purely technical means. Wayfinding is an illustrative example of a problem, which does benefit from a simultaneous attention to the technology, user interface design, information architecture and knowledge organisation. Information architecture and especially knowledge organisation related issues have received, however, considerably little attention in the virtual reality context.

The beginning of the archaeological virtual realities may be traced back to the 1980's. The early reconstructions have been criticised heavily on their poor scientific quality. The projects were driven by engineers and computer scientists working in computer graphics companies, which were enthusiastic about the possibilities to demonstrate their new technologies. In some occasions the teams consulted archaeologists, but in many cases the archaeology professionals first saw the realisation only after its completion [291]. Forte criticised the projects in 1998/2000 for (so far) only seldom incorporating any serious archaeological contents and thus for being only scarcely able to contribute to any archaeological research questions [281]. Innovative, research driven virtual reality implementations, and reports on the scholarly insights reached through examining a virtual reality model have been published (e.g. [327][290]), but generally speaking, they are still in minority compared to the popular presentations after nearly a decade after the expression of the initial concerns in the 1990's. Some of the reasons for the lack of the contentual interests may be traced back to the initial exhilaration caused by the new emerging technologies, which was coupled with inexperience, the prevalence of exploratory approaches, and the consequent lack of processual rigour and conversance (ref. e.g. [531]).

Even if the lack of resources is frequently a major shortcoming of the 'virtual archaeology', the financing does not need to affect the scholarly quality of the results as, for instance, the report of Goodrick and Harding demonstrates [327]. The rather low level of financing and resourcing, which is typical in everyday archaeology, does not allow a regular fetching of the state-of-the-art virtual reality products

[787]. It does also decrease the possibilities and the pace of adapting new technologies. The issue has been discussed in several occasions [317][785]. Suggestions have been made on how some easy-to-use general purpose and custom built applications might be integrated to the archaeological work processes. In spite of the good efforts, the applications remain expensive and difficult to use, as two of the informants of the current study have stated [A, F] (on citing the informants ref. Section 4.2). The fast and diffident developments on the software and hardware front have made the practise of teaching virtual archaeology and archaeological computing in general rather difficult even if a high end system is not a definite prerequisite of interesting research results. The tendency to adopt new subjects (such as the archaeological computing) rather slowly in the university curricula has paired with the difficulty of deciding on a purposive directions of the education [785].

Fernie and Richards [267] distinguish seven partly overlapping categories of virtual realities (which are complemented here with additional illustrative examples):

1. **Training applications** allow users to practise a process repeatedly in a no-risk environment. For example, users might dig an archaeological site, trying different strategies without the risk of destroying important evidence. Similarly, outside the context of archaeology, a student of flight may practise extreme situations on a flight simulator [614][516][685][831][640, 114].

2. **Educational applications** including virtual visits and simulations (e.g. in [717][55] [640, 113], also [765]). For example, a virtual visit to a museum, which is too far away to visit (e.g. [406]) or does not exist in the real-world. Historic battles may be simulated allowing users to see 'what would have happened if?'. Delicate objects may be used and tried in a virtual reality environment [119] and even entire historic landscapes may be recreated by visuallly 'removing' the later stratum [102]. Virtual realities do also allow simulated travelling back and forth in time [173].

3. **Visualisation** allows to evaluate an architectural design of a building and to make reconstructions of ancient constructs on the basis of archaeological evidence. Models allow users to explore something, which might be too large or too small (e.g. molecules [253]), in another frame of reference [60], or too vulnerable [646] to be touched in reality. The principal advantage of a virtual reality visualisation is its capability to visualise complex information both *in situ* [455][406][614] and in distance [95].

4. Applications of the virtual reality for **conceptual navigation** enable, for example, users of a library or an archive to find the information they need in a logical or physical space (e.g. [726][282]).

5. Virtual reality **allows designs and composites to be visualised, tested, evaluated and reevaluated** (e.g. [429][474][44][569]). For example, a design application might allow a choreographer to see a dance in action. Another application might provide means to evaluate a space station or a rover [253]. Testing may be used also in the automotive industry [831] and in archaeoastronomy (e.g. [77]).

6. **Entertainment applications** include virtual art galleries and games. Virtual reality may also be considered as an art form on its own right [64][151][331].

7. **Collaborative Virtual Environments (CVEs)** allow users to interact with each other in a virtual world. The techniques provide means to develop an experience of virtual communities, thus adding the social dimension to a single person experience. A virtual environment allows also collaboration with remote appliances, remote control and telepresence over distances [253][429][428].

Experimental designs cover even more wider range of simulations from a puppet theatre and virtual conducting of an orchestra [744] to diverse educational [136] contexts. Within the domain of archaeology, a typical tripartite view on the applications of virtual realities consists of research, pedagogy and the public dissemination or consumption [431] (for some state of the art examples ref. [640, 103-113]).

All the above mentioned applications implement several forms of information interactions. Undoubtedly the most typical method of employing a virtual reality application, is to use it to communicate spatial information in order to provide (create) knowledge on spaces, routes or areas [500][846][267]. The information may be abstract or it may represent a physical setting. The objective of using virtual realities in communication is to take "a collection of otherwise unintelligible data (points, facets etc.) and present it on screen in a way that the user can interpret it, in keeping with the developer's hopes or intentions" as the aim was described in Fernie and Richards [267]. Besides explicating the relationships, another benefit of the virtual realities is in the multiplicity of the senses involved in the experience [457].

Despite the wealth of the enthusiastic reports of the promising virtual reality applications, the precise degrees of their success are often difficult to determine. Recent years have seen several projects aiming to understand, develop and evaluate virtual reality technologies in workplace contexts, but in spite of these efforts the evaluation of the virtual reality systems is still very much in development. The formal attempts to improve usability have been concentrated so far, primarily on the interface usability issues instead of work or work task performance (e.g. [322][830] cf. with [101][744][436] [114][452][510][113][718]).

In purely practical sense, the remark made in the guidebook *Creating and Using Virtual Reality: a Guide for the Arts and Humanities* [267] that it is often preferable to concentrate less on the definition than on the technology, makes perfect sense if the intention is to produce immediate results using an already existing idea. Working definitions are adequate as far as the objectives are practical and rather short-term in duration. When the considerations are stretched over long periods of time and they are expected to accommodate multiple context and situation dependent factors, a more thorough understanding of the phenomenon becomes an imperative.

3.2.2.3 Aspects and elements of virtual realities: The viewpoints of dreamers, developers and philosophers

The conceptual ambiguity of the 'virtual reality' has produced various attempts to analyse the notion (e.g. [500]). The liberal designation of a diversity of systems as 'virtual realities' has lead to a general terminological vagueness in the current debate. The most substantial source of disagreement seems to be the variety of the contexts of reference. The focus of the critical concerns depend on the affiliation of the debater to one the groups of 'dreamers', 'developers' or 'philosophers', as Ryan categorises the principal scholarly viewpoints [650, 49].

From a practical systems development point of view of the 'developers', the key issues of the virtual realities are related to the implementation of effective tech-

niques of interaction in a computer generated virtual environment. The 'philosophers' are, on the other hand, primarily concerned of the future implications of the potentially emerging technologies. Visionary reflections of the 'dreamers' on the future virtual realities might be easily judged as irrelevant science fiction from the scholarly and professional point of view. It is plausible to state that such all-embracing proclamations like the one cited by Ellis that "VR is a very special field where there are no experts, and everyone can be one" [251, 18] are vividly hyperbolic. Yet the "myth" of the virtual reality does bear multiple levels of pragmatic meaning to the practical implementations of the virtual reality technologies [650, 14]. Both the visionary and the popular debates have had a deep impact on the practical and scholarly development of the virtual reality systems. It is likely that any eventually appearing technology is as well going to cause in the future social and political challenges [251, 22], which might well be anticipated in the visionary explorations. Acknowledging the importance of the visionary views does not diminish the value of the critical observation of Ellis that the development of the virtual reality technology and applications is hard specialist work, which requires both technical training and an understanding of the preceding contexts of the research [251, 18].

In an attempt to establish an analytical framework for the discussion, several researchers have proposed that the term virtual reality should be replaced by other theoretically more warranted terms [734, 4]. Rationality of this approach is, however, somewhat doubtful, because 'virtual reality' is already established in the scholarly and public debate (ref. already in the early 1990's [734, 4]). Besides the propositions to replace the virtual reality with some related terms, attempts have been made to reach a more analytic itemisation of the concept 'virtual reality' itself [734, 4-5]. At the same time the tendency to assume some analytic distinction between the relating terms such as the 'virtual reality' and 'virtual environment', has become more prevalent.

The variety of the propositions reflects the background of their authors in the 'developer' or the 'philosopher' minded communities of discourse. Gunkel discusses the virtual realities as simulations in contrast to considering them as 'images' [343], whereas Kreitler refers to the virtual realities as systems of meaning [458]. Information systems development, or 'developer' oriented viewpoint typically assumes a pragmatic 'virtual reality as an ultimate display' type phrasing of the notion. Virtual reality is seen from the developer viewpoint as a type of a user interface [321, 2][473]. It is often referred to as a 'virtual environment' (e.g. in [718]). In this perception the term virtual reality has become implicitly reserved for the philosophical considerations, apparently due to its problematic connotations especially with the notion of reality. In this context, Kantner has proposed a useful distinction between realism and reality. According to him, the 'reality' of virtual realities should be considered to be closer to the notion of realism (i.e. what is realistic) than to the reality (i.e. what is real) [431]. Some authors and projects have assumed, however, a precisely opposite conceptualisation. They perceive a virtual reality primarily as a technical and presentational system and a virtual environment as a "computer-generated experience of the participant" [831]. Unrelated to their respective connotations, most explications of the concepts 'virtual reality' and 'virtual environment' reflect closely this technical pragmatism. Realisation of a system presumes implementation of several functional features, which are specified as the elements of virtual realities. For example, according to Sheridan [686, 121-122], the features or elements of a virtual reality are :

1. Sensory information
2. Control of the relation of sensors to environment (ability to move and interact with the environment), and
3. An ability to modify the computer generated environment.

These elements describe well the general expectations of a technical implementation of a virtual reality. They do allow the construction of hierarchies of how the criteria may be reached in the screen-based, so called desktop virtual realities, in virtual reality rooms or by using a head mounted display. The technological viewpoint lacks, however, a clear notion of the implications related to the technical implementation. Latta and Oberg acknowledge the existence of the aspect of the 'experience' in virtual realities, but do at the same time, make a clear distinction between its operational and experiential effects [473]. The present study assumes a less bipolar view and insists that the operational and experiential effects may not be treated as separate notions. On the contrary, they do contribute directly to the outcome of one another. The central question is, what functions the implemented system is expected to serve in the social and cultural context of its use. As Machover and Tice underline, the enticing aspect of the virtual realities is their closeness to the human experience. Humans make virtual realities interesting from the humanities and the cognitive science points of view. Human actors and their experiences are a constituent premiss and a measure of success of the technical development of the virtual reality systems [500][826][267]. The 'philosophical viewpoint' [734][695] needs to be credited for attempting to address this precise issue in a far more detailed manner than the technological or visionary discourses. The technological discourse tends to see humans merely as 'users' of technology and the visionary viewpoints typically lack an equal level of analytical rigour expressed in the philosophical ponderings.

In an attempt to scrutinise the unique and essential elements of the virtual realities on a human-level, Pimentel and Teixeira propose that there are two aspects, interaction and immersion, which constitute a virtual reality [591, 11][649][650, 2]. Basically these aspects may be linked with the elements of Sheridan (ref. above on the preceding page). The abilities to move, interact and modify do have a clear relation to the notion of interaction. The 'sensory information' is similarly related to the immersion. A direct mapping of the concepts is, however, rather difficult to accomplish in practise. Both the interaction and the immersion do represent more complex phenomena than a basic type of interactionism. The distinction is reflected in the set of attributes proposed by Wilson [831]:

1. Sense of existence or being within a three-dimensional space, and interacting with three-dimensional objects.
2. Sense of involvement (or presence) in that virtual environment (i.e. the three-dimensional space) and a feeling of transportation to somewhere, which is not the actual setting in which we are participating.
3. Ability to carry out direct interaction, using multiple modalities with a computer generated display, either by updating it through movements and actions, or by moving and manipulating virtual objects within it.
4. Responses from the environment to the participant's control actions and movements are perceived as immediate or close-to-immediate.

The technical aspects of sensory information and manipulation contribute to the realisation of experienced immersion and interactivity. Therefore it is suggested that a more meticulous explication of the two notions is needed.

3.2.2.4 Immersion

The special quality of immersion (or presence, see below, the sensory dimension of virtual realities, the sense of being there) is a problematic concept, as Ryan remarks [650, 14]. Immersion is used colloquially to denote almost any engaging experience. In spite of the evident problems of describing the nature of the immersion accurately, it is clearly an important factor of a virtual reality experience, if not the most important one [556][724]. The immersion establishes a virtual reality and its perceived quality as a human experience.

The sense of being immersed has been described from a variety of perspectives. Ryan perceives immersion as a connection between a simulated reality and an actor. The proposition explicates well the essentiality of the connectedness, but leaves the exact nature of the connection undescribed (cf. [650, 15]). In Fernie and Richards [267], the immersion is, on the other hand, defined as a three-level concept: full, partial and augmented. The proposition of Fernie and Richards suggests that an augmented reality should not be considered as immersive. The standpoint is, however, rather problematic. In the context of the present study, it is suggested that an augmented reality might be potentially as immersive as a completely virtual reality. A non-technical understanding of the 'sense of being immersed' does not necessary have to deny every link to the actual realities. An immersive experience might well be a seamless combination of the actual, which is complemented with a virtual. Langan argues that the virtual realities do not attempt to invoke a concrete sense of a being there, but acknowledges the possibility of that happening. Virtual realities, like all cognitions, require that we refer back to an experience of a fuller context, if we wish to judge their truth. Ultimately the full context is some part of the experienced life-world [463, 125].

Within the human-computer interaction oriented research of the virtual realities, there has been a distinguishable preference for the term 'presence' to denote a broadly similar concept to the immersion [734, 5-7]. 'Presence' has been used to signify the same 'the sense of being there' as the immersion (e.g. in [359][59][267][634] [309]) besides being referred to as a distinctly practical term as in Schloerb [666]. More recently, the presence related research has been increasingly oriented towards a broader understanding of the presence as a concept, which grasps also an unphysical sensing of the non-actual influences. Stanney et al. have argued for the need of analysing more meticulously the engagement aspect of the virtual realities by distinguishing the immersion and the presence [718, 458-459]. The authors refer to the immersion as a semi-physical relation between an actor and an environment, while the 'presence' functions essentially as a cognitive level feeling of 'being there' [718]. Slater and Wilbur have suggested another distinction between the two terms by describing the immersion as "an objective description of aspects of the system such as field of view and display resolution" [697]. A user does not have to be immersed fully, to feel a sense of presence. Precise outlook, functionality and the degree of engagement varies between individual virtual realities and theoretical considerations, but the broad idea of an immersive or engaging environment, space or experience [591, 11] of interaction, has shown considerable persistence in numerous notions [687, 54] of 'virtual reality'.

The Exeter, UCL and Stanford based Presence project has set forth to explore

the various characteristics and issues relating to 'presence', its emergence, documentation and reproduction in diverging contexts and viewpoints from virtual realities and performing arts to the computer science and archaeology [309]. Before this on-going effort, Schuemie et al. [670, 199] have made a broad survey on the factors, which constitute presence in the virtual reality environments. They propose three factors: vividness, interactivity and user characteristics, which all are underpinned by earlier empirical findings [670, 199].[4] An important result of the Schuemie et al. survey is that all of the referred studies reviewed by the authors do indicate the constituency of the user characteristics. According to the findings, the emergence of the presence is highly dependent on the individual preferences and characteristics of the users. The characteristics, which were revealed by the reviewed studies, distinguish the importance of the age of the user and her preferred system of perception (visual or some else) [670, 198]. Witmer and Singer have further distinguished the inclination of getting passively involved in activities, ability to concentrate while distracted and the frequency of playing and getting involved with games [847]. It is likely that the user characteristics comprise multiple factors besides the discussed ones. In the scope of the present study, the preferences of the individual users are important to keep in mind. However, because the perusal is focussed on the information work instead of an individual performance, the personal preferences remain basically as a matter of interference.

The concept of 'vividness', which was denoted by Schuemie et al. [670] is cited from Steuer, who uses the notion to explicate the representational richness of a mediated environment. Vividness is an element of the presence and telepresence besides the 'interaction' [734]. Vividness seems to be close to something, which might be described as a part of the capability of evoking immersion [734, 11-14]. Steuer discusses vividness through the aspects of 'breadth' and 'depth', and describes the spectrum of transmission, which is involved in the communicative process [734, 11-14]. Steuer recognises 'depth' as a quantitative 'quality' of the sensory reception in terms of bandwidth. In spite of this notion, the concept of vividness is still lacking a contextual quality in terms of a 'fit for the purpose'. Díaz-Kommonen uses the concept of 'illumination' to denote a similar, assumed characteristic of the visual presentations to 'contribute to the understanding', in the metaphorical sense of "shedding light on the subject" [231, 116-117]. Basically both the vividness and illumination may be perceived as complementary concepts to the immersion. As a general observation of these complementary notions, they do highlight some of the important characteristics of the phenomenon, but do still fundamentally reside within same conceptual boundaries with immersion and presence.

In summary, the element of immersion with its diverse alternative and adjunct concepts, is clearly a constituent constructor of the virtual reality experience. It is a state of deep connectedness between the actors and the virtual context. Immersion is related constituently to the individual life worlds and the personal characteristics of the actors, but is rather a characteristic of the relation or a bond between an actor and the virtual context, than a personal trait.

3.2.2.5 Interaction

If the immersion is a bond between an actor and a virtual reality, the interaction represents its making. There are two distinct levels of perusal when it comes to

[4] The effects of the interactivity are discussed (Section 3.2.2.5) in more detail with a reference to the broader notion of virtual realities.

the interaction in the virtual realities. Interaction is assumed to create an effect of interacting with real things (not pictures or representations of them) [128, 63]. The things and their reality is, however, a question of taking a physical or a social standpoint. The difference in the levels of perusal is illustrated by comparing two different analyses of the virtual realities. Stanney et al. propose a framework for the evaluation of virtual environments, while Steuer attempts to establish a conceptual frame for the 'virtual reality'. In technical sense, Stanney classifies interactions to 1) travel, 2) selection and 3) manipulation [718] in a similar manner, in which Sheridan (ref. on page 71) describes the elements of virtual reality. In contrast, Steuer breaks the interaction down to the three aspects of speed, range and mapping. Speed refers to "the rate at which input can be assimilated into the mediated environment" [734, 15]. Range denotes "the number of possibilities for action at any given time" [734, 15], and mapping "the ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner" [734, 15]. As Shields remarks, the proposal of Sheridan is lacking an explicit reference to the social dimension of virtual realities [687, 55]. The same remark applies to the categorisation of Stanney et al., but also partly to the notion of Steuer. The proposal acknowledges the importance of the contexts as background factors and cites the ecological tradition of perception studies (i.e. [311]), but implicitly denies the possibility of their active participation (in sense of constructive perceptionism, e.g. [335]).

An ability to interact with the environment suggests a need of a social kind of interaction beyond the means of physical interaction. The notion of social interaction does, however, demand some further emphasis as the effective means for interaction and social communication have been commonly referred to as a type of an ultimate measure of the virtual realities [687, 55]. The notions on the constituency of the indistinguishability of a virtual reality from the 'real' reality by Sutherland and Kruger, have been recognised to be considerably dependent on the presence of a social interaction [346][202][349][481][122][642]. A typical virtual reality of the early days was scarcely populated due to the need to reduce the amount of required computing power. Nowadays the technology permits complex and detailed environments with multiple modalities of interacting with the computer and with the fellow human beings by using a computer [334]. Despite the technical advances, the environments, which have been rather poor in details, but strong in the means to interact, have proven to be exceedingly effective and popular among the users. Text-based chats and multi-user dungeons (MUD) are in the hinge between being and not being virtual realities, but as some kind of semi-virtual realities, they have been hard to outweigh in popularity [687, 54-65][206]. The pertinence of the social anchors within a virtual reality underlines the plausibility of the argument that the sense of being there, and subsequently the experienced virtual reality, does reside in an essentially human sphere of being, as Steuer [734, 6-7] and Heeter [359] emphasise. The virtual reality is not only in the domain of technology as the 'developer' viewpoints either explicitly or implicitly suggest (e.g. [686]).

3.2.2.6 Dimensions, multimodality and distance

Besides the notion of social dimension, the essentially 'developer' oriented elements of virtual realities of Sheridan (ref. on page 71) lack the implicit expectation of a perceptual spatiality of the information [734]. The notion has been closely tied to the virtual realities from the colloquial idea of perceiving them as three-dimensional spaces [687, 55] to the experiments of Sutherland and Kruger. Partly

in agreement with Sheridan, it is arguable that the concept of 'virtual reality' does not necessarily need to suggest any particular visual dimensions of the perception [695].

Similarly, the dimensionality of the virtual realities does not have to appear as a simulation of the dimensionality of the natural world. Practise has shown some promise in using landscape and nature metaphors in visualising information [242], but the findings on the general applicability of the notion of 'naturality' are far from being uncontroversial. Even though the inclusion of the natural world dimensionality may in some contexts appear to be a powerful tool for increasing the interactivity and immersion, it is necessary to note that in a 'virtual reality' these conditions are not preemptive. Interaction, presence and immersion may be accomplished in a non-natural setting of dimensionality as long as the users are capable of adapting to the inner logic of the hypernatural dimensions. Text-based adventure games are an illustrative example of this kind of an adaptation [698]. If the intention is to make a point of the clarity of presentation without any specific intention of forcing the user to adapt to the environment (such as is the case in information visualisation), the increased dimensionality may be counterproductive (e.g. [439]). Steckner proposes an approach of relying to the combination of a tacit communicative basis of the environments and a trained information access [727]. Due to the diversity of the user contexts, a combinatorial approach is undoubtedly needed. The principal challenge remains in a reliable distinction between the tacitly communicated dimensions and the dimensions, which call for a conscious training.

Whilst no particular dimensions are necessary, dimensionality itself constitutes a fundamental aspect of the virtual realities. The fluidity, or the flexibility [267], and the complexity of the virtual realities and their possible dimensions constitute the multidimensionality and multimodality as the fundamental characteristics of the medium, leaving nothing static to remain. Besides the visual sphere, another plausible dimensions of the presence and the modalities of communication comprise the remaining human senses (audition, olfaction, gustation, tactition, thermoception, nociception, equilibrioception and proprioception [311][182]), time and diverse cognitive, cultural and intellectual perceptions, interpretations and world views, which affect the understanding of the basic sensory reception.

Benedikt [84] proposes a distinction between *extrinsic* (three spatial coordinates, time) and *intrinsic* (shape, colour, texture etc.) dimensions of the virtual reality environments. The extrinsic dimensions perform a coordination duty, while the intrinsic dimensions signify the *character* of a point in an n-dimensional coordinate space. The absolute distinction between the extrinsic and intrinsic dimensions is controversial in a similar manner to the perception of dimensions and time, which vary along with other variables. The distinction does, however, place an important emphasis on the duality of the virtual reality experience. A virtual reality does construe in the virtual reality itself, but also in the convergence of the intra and extra virtually real dimensions. Kryssanov et al. emphasise the importance of multimodality, irregularity, openness and the varying efficiency of the communication in hypermedia environments, of which the virtual realities are an example. The communication in a hypermedia environment is described in the proposed model of hypermedia-communication behaviour as a mutually-orienting perturbation of coupled autonomic systems [459], which may be seen in Benediktian sense, to emerge through the distinction between the two kinds of dimensions.

The complexity of the dimensions couples with an implicit notion of distance, which is related to the concept virtual reality. Steuer defines virtual reality as a real

or simulated environment in which a perceiver experiences 'telepresence' [734, 7]. For Steuer the telepresence is a form of mediated presence, the sense of being in the environment begotten through a communications medium [734, 6] (ref. also [717, 101-103]). The distance may be a tangible quality, but it is equally related to the distance between the actuality and the non-actuality (ref. Section 3.2.1). It is essential to consider the distance as a quality of the virtual realities 'as not being here even though practically seeming to be here'. In a practical sense, it is important to tender the continuing existence and the emergence of the presence and immersion, instead of causing 'virtual absence' by the new infrastructure. Büscher et al. have expressed their concern on the imminence of this particular phenomenon by underlining how an introduction of new technologies may destroy the benefits of physical co-existence [133]. In a virtual reality, there is no physical presence to destroy. If a virtual reality is used to substitute the need for physical presence at a meeting, on an archaeological site or in a cooperational work, the technological presencing may well precipitate the emergence of an actual absence instead of a virtual presence. The principal interactions cease to be between human-beings. They begin to emerge between the man and machine.

To summarise the position of the dimensionality in the virtual realities, it is necessary to refer to the dimensions as an infrastructural framework. The elements of immersion and interaction may be conceptualised as measures of the relationship between a user and an infrastructure, while the dimensionality is an element, which maps the terrain between the two and forms a basis for the connection to exist.

3.2.2.7 Virtual reality: engagement, interaction and dimensionality

Hillis has suggested that the term 'virtual environment' (VE) should be used for digital stage-sets and dramatis personae, which function within a virtual reality [371]. The virtual reality itself is a formation consisting of the notions 'virtual environments' and 'virtual technologies'. Shields builds on Hillis and assumes a standpoint, according to which, a *virtual environment* is essentially a framework for a digital existence [687, 59-62], whereas the *virtual reality* is a super category and a state of social and cognitive being in a virtual environment constructed by incorporating a set of virtual technologies. This comprehensive suggestion to map the aspects of virtual reality with the present and historical virtual milieus is explicated in the figure 3.2 (from [687, 58 Table 3.2]).

The conceptualisation proposed by Hillis represents an attempt to synthesise the theoretical and technical approaches (ref. Section 3.2.2.3). The model describes what a virtual reality is. The illustration does, however, lack a clear notion of the entry points where and how the virtual realities interface with the human activity, which emerges through the implementations of the virtual technologies in virtual environments. A virtual reality is a result of a coexistence between virtual environments and virtual reality technologies, but it emerges only when a human actor becomes 'presenced' (i.e. obtains a presence) in a virtual reality. To illustrate this act of presencing, the current study proposes a new point of entry for the categorisation of the virtual realities to complement the earlier considerations, including the model of Hillis. The model attempts to establish the entry points through which a virtual environment 'emerges' a state of virtual reality. The proposed elements (illustrated in Fig. 3.3) consist of:

1. **Engagement**, which comprises immersion and presence (which further con-

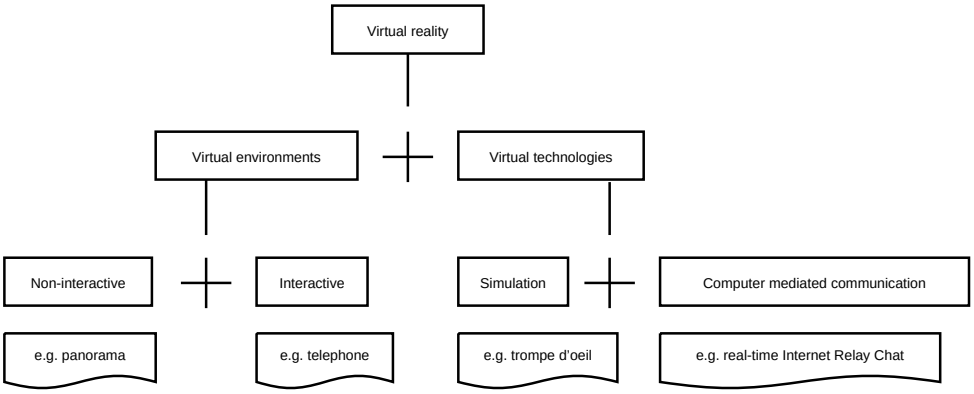


Figure 3.2: Aspects of virtual reality [687, 58 Table 3.2]

sist of the quantitative aspects of the breadth and depth), and the qualitative notions of the contextual affordances and constraints;

2. **Interaction** consisting of both the physical (actor with virtual reality) and social dimensions (human with human, human with environment); and

3. **Dimensionality**, which denotes the complexity and structure of a virtual reality.

The triangle (Fig. 3.3) addresses the question of the central entry points, where the virtual realities emerge in human contexts. The implementation of the virtual technologies of simulation and communication in the virtual environments, results in the formation of multi-dimensional systems called virtual realities, which establish varying levels of engagement and interaction in human actors.

3.2.3 Knowledge and information in virtual realities

3.2.3.1 Information viewpoint to the virtual realities

The discussion so far has demonstrated rather plainly that any explicit proposition to define 'virtual reality' narrowly, is bound to be equivocal. Following the basic viewpoint of the present study to consider the virtual realities from the information management point of view, allows the current perusal to concentrate on the particular subset of the characteristics, which are important from that information perspective.

In this study, the concept of virtual reality is perceived through its constituent elements: *dimensionality*, *engagement*, and *interactivity*. It is presumed that the notion of interactivity comprises the senses of changing existing entities, creating new ones, and communicating, within a virtual reality. The dimensionality implies that a virtual reality may be construed by a theoretically unlimited number of dimensions. The dimensions contribute to the presence, immersion and interaction, which form the essence of the experiences denoted as 'virtual realities'.

The practical examples of the virtual realities illustrate well the prevailing tendency of the virtual reality debate to be pronouncedly concerned with the user-VR-interface issues (e.g. [524][437]). The aspects of the scientific, scholarly and popular interest have been concentrated around the technical accomplishment, design (e.g.

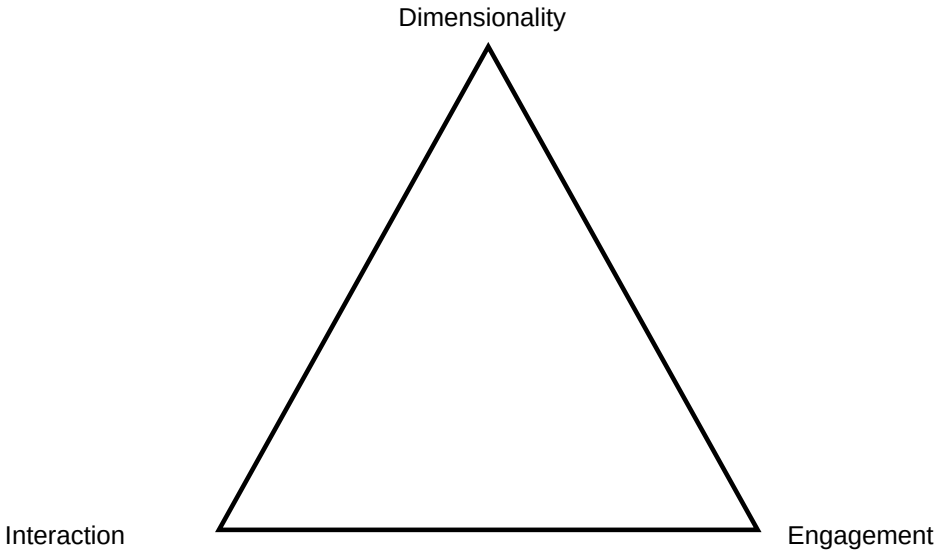


Figure 3.3: Elements of virtual reality

[62]), human factors (e.g. [831]) and, for instance, the cultural, social and educational (e.g. [599]) implications of the virtual realities in the contemporary contexts. Some explicitly information related matters have been introduced to the research agenda in conjunction with the issue of bringing the users and their tasks together (e.g. [445][831]).

The intrinsic frailty of the analyses of the human-factors and the cultural and practical implications of the virtual reality systems is the same, which applies to the user studies in general. If a study is based on experiences gathered during evaluations, which are specific to individual technological systems, the analysis will necessarily fail to grasp the entire scope of the broader contexts and situations of the purposes, meanings and values related to the work of the participating human actors. Even if a user is described to be 'satisfied' with a virtual reality system or it is possible to prove that the person learns something during the period of use, the result is still very indecisive. The observations *may* illustrate some aspects of the soft system, which involves the virtual reality and the user. They do, however, almost certainly fail to indicate the reasons of the success.

In an attempt to go deeper in the analysis of the relationship of the virtual realities and the human intellect, Forte proposed an approach of "cognitive virtual archaeology" in 1998 as a new agenda for investigating the role of cognitive aspects of the virtual realities in the process of archaeological reasoning [281]. Perceiving a virtual reality as a vehicle for human reasoning is an important step towards understanding it in a cultural-contextual perspective of work and information work, but it is still important to remember that the 'cognitive', is only a part of the entire perspective.

All in all, an explicit information oriented viewpoint to the virtual realities, is absent from the literature.[5] Virtual realities have been referred to as information storages or compilations of interpretations. The consequences of these notions have

[5] Compare with the observation made by Cunningham, Knowles and Reeves on the notion of digital libraries [203].

remained, however, rather obscure. Consequently, as Díaz-Kommonen observes, very little work has been done either for understanding or classifying the types of visual information they might offer [231, 113]. Equally little interest has been focussed on explicating the precise cognitive methods of the information transfer in the virtual realities [717].[6] The notion of Warwick on a virtual reality as a way to integrate man with information has been cited as a practicable fact [106][745][712], without specific concern for its implications. Virtual reality is plainly something, which integrates the man with a machine. The eventual consequences of this perspective have been placed only infrequently under any direct scrutiny. It seems that the references to the information dimension tend to take granted that the users become informed by using a virtual reality without making any explicit references to the mechanisms of the process of *becoming* informed.

To reach a more structured information oriented viewpoint to the virtual realities, the elements of dimensionality, engagement and interaction call for a thorough scrutiny. The essence of the dimensionality may be compared to the approach of representing natural language documents (in information retrieval studies, ref. [654][653][671]) as an n-dimensional vector space composed of words. In comparable terms, a virtual reality may be perceived as an n-dimensional vector space composed of related units of information (or knowledge according to the knowledge organisation discourse). From the structural point of view, a virtual reality may be seen as an *n-dimensional knowledge organisation system*.

A virtual reality is not, however, a mere space. According to the conceptual understanding of the nature of virtual and virtual realities assumed in the theoretical consideration of the concept 'virtual' (Section 3.2.1), the relevance of the virtual realities is not merely in (re)presenting data and information. The strength is in their capability to steer the subsequent knowledge formation processes by their infrastructural and contextual affordances, which are based to the special characteristics of the notions 'virtual' and 'virtual reality'. The argument compares with the somewhat provocative remark of Morville that plainly visualising something, does hardly make anything more findable [536] or indeed, more intelligible. In a virtual reality, an image is not only for seeing. It is fundamentally related to the notion of understanding (ref. [507]) and acquiring knowledge through a synthesis of information [585]. Referring to a virtual reality as an image is an act of copying the form without an understanding of the pertinence of its historical [585], contemporary and emerging contexts in the sense of *engaging* the participants.[7]

Besides the notions of dimensionality and engagement, the virtual realities do grasp the act of interacting. Iadeira and Blake observe that a virtual reality is not superior in communicating content (understood in a textual sense), but in mediating experiences [462]. The benefit of the virtual realities is not only in the multidimensionality of a form, but in the emergence of an embedded interaction and engagement within a multidimensional structure, whether result is a simulation (ref. [585]) or a system of knowledge organisation. The relationship between the information and the associated human actors needs to be contextual in order to be effective (ref. [55], cf. [410][673]). The notion is underlined by the pertinence of engagement and presence in the effectiveness of a virtual reality aided psychological therapy [670]. Consistently, it is plausible to suggest further that when the sensed presence has not correlated with the task performance (e.g. [661][498]), the task character-

[6] Sic! the observation is over a decade old.

[7] The perception of the virtual realities as an embedded process rather than as a representation, contrasts with the propositions of using virtual realities to externalise mental images and representations (cf. e.g. [656]).

istics (or other factors) have been emphasised among the concurrent modalities of involvement instead of the immersion [661]. If the essential information is possible to mediate, and is subsequently mediated effectively without resorting to the immersive function, the time used for the emergence of a presence becomes unnecessary and impairs the task performance. As Anania writes, "there are a number of applications areas where a good sense of presence is needed" [23, 61]. However, to complement the notion, there are also interactions, where the sense of presence is less crucial.

But then what is the information infrastructure of the virtual realities like? Agreeing with Forte, a virtual reality is not perceived in this study as an antithetical (eco)system in Batesonian sense [282, 3]. In contrast, the proposition is based on a Levyan standpoint. It suggests that the virtual realities are parallel ontologies of perception and autointerrelated information [282, 3]. The ontology is constantly reconstructed during each encounter with the human actors [282, 14]. Forte ([282, 283] cf. [70]) suggests, following Bateson, that this encounter may be mapped. However, if a virtual reality is considered to *be* an ontology (i.e. a conception relating to the nature of being), the information *is* necessarily an integral part of the virtual reality itself. Therefore the act of producing a "concrete map of the communicative DNA" of a virtual reality ought to be impossible (cf. [282, 17-18]), because there is no DNA, but only a sequence of consecutive simplifications.

Limited *mapping* of the differences (in Batesonian sense) between two virtual realities might be still considered to be a possibility. The representation should be expected to be, not only a visualisation of an abstract conceptual code of the author, but to include also the necessary spatial, cognitive, affective, social and cultural context of the inferences. A map is another virtual reality with its intrinsic dimensionality, presence and interactivity, and a representation of one interpretation of the original infrastructure. In practical terms, a three-dimensional cybermap may serve as a visualisation and an instrument for understanding the premises how a virtual reality is built (ref. the 'maps' of Bateson [70]. Visualisation of the data objects and their interrelations as a matrix of informatively coloured objects serve a purpose (e.g. as in [282][726]), but it is argued that not the purpose of realising the full potential of a virtual reality. Each virtual reality is from the infrastructural point of view, an intrinsic, yet contextual entity, which may be described only within the framework formed by itself.

The notion of interactivity applies also to the use of the virtual environments as a framework for visualising information [128, 69]. There is a major difference between visualising information by using a virtual reality system as an instrument, and in processing the virtual reality as information. The infrastructural viewpoint to the concept is related to the one of Ryan, who took the virtual reality as a starting point to explicate narratives [650, passim, especially 12] (ref. also [29]). In the present study, the virtual reality is a knowledge organisation system instead of a narrative, but in spite of the differences in the perspectives, the two approaches do share a conceptual viewpoint. Virtual reality is essentially a form, which is explicated with a reference to the notions of work, information and information work. For Ryan the goal of art is a synthesis of immersion and interactivity. In the present study the immersion and interactivity are the fundamental qualities and constructors of the information and any information related interactions.

Winn discusses the effect of immersion through the notion of constructivist learning theory. Immersion provides the user with a first-person experience and decreases the need for symbolic interactions [340]. This remark suggests essentially

that in a virtual reality, a user may interact with the environment in a more direct manner than with less complex surrogates, such as text or static images. Hayles explicates the connection between information and virtuality in her *Condition of Virtuality* [355]. For Hayles the contemporary era is an era of virtual after the oral and written phases of information transfer in the human societies [355]. The actual condition of virtuality is the cultural perception that material objects are interpenetrated by information patterns. If this condition is linked with the notion of information as a "cultural concept referring to a contextual property" (ref. Section 2.4.1), and with the elements of virtual (Section 3.2.1), information and virtuality coincide if information articulated through the emergent properties of immersion, dimensionality and interactivity within its context.

Ellis makes an important remark from the information viewpoint, concerning the future prospects of the virtual realities. Virtual realities, like any technique, could break through, either due to the possibilities to use a virtual reality to serve in very specific conditions, or due to its capability to provide an affordable generally applicable platform and solution to a broad range of problems. Ellis gives a flight simulator of a specific type of aircraft, as an example of the first type of application and the spreadsheet, as an example of a powerful general application, which justified the concept of microcomputer in the turn of the 1980's [251]. The benefits of any virtual reality based system do have to be unique, not merely significant, to constitute the development and implementation effort as Ribarsky et al. [618] remark. This pertains especially the current discussion on the virtual reality based knowledge organisation. At the present, before the introduction of a 'killer application', the systems are necessarily time-consuming to develop, will require arduous integration to the existing social and personal practises and have besides the benefits, diverse other, not necessarily beneficial, unpredictable consequences to the broad spectrum of the users' activity. Even if the virtual realities eventually would become a commonplace, before that happens, they are not automatically any more natural to use than any other systems. Virtual realities, like all knowledge organisation systems, are necessarily 'unnatural' in being deliberate abstractions of the reality. They need to be shared between multiple individuals and should provide both broad and deep benefits to become truly meaningful.

In summary, it may be concluded that the unique elements of the virtual realities, presence, immersion and interactivity, are conclusive also in the context of the information viewpoint. Therefore it is suggested that these elements should serve in a virtual reality based knowledge organisation system as the central means to conserve and communicate knowledge, and to cut down the intellectual distance between the assumed knowledge and its representations. The aspects of engagement and interactivity may serve a dual purpose of familiarisation with the inner logic of the knowledge organisation system and in the subsequent knowledge communication. As the user is injected into the scene, it is possible not only to see, but also to imagine fictional distant and alternate realities [687, 65]. The possibility of imagining and experiencing beyond the physical reality [687, 65-66], and rapidly altering the infrastructure, increases the potential of the virtual realities as a knowledge organisation and communication system. A virtual reality may also act as a filter [687, 69-73] to the physical world and to the knowledge in a non-'virtual reality'. Comparably to any other system of knowledge organisation, the virtual realities afford and constrain distinct avenues of emerging knowledge. In a virtual reality, the ecological filter may be altered to instantly delimit or expand the view to the knowledge structure through the immediacy of engagement and interaction.

3.2.3.2 Ecology of knowledge organisation in virtual realities

Because of the interactivity, a virtual reality is not a static or a pre-programmed entity of organised information. A virtual reality shapes itself and its adjacent actors and realities. Virtual reality is an *actant* in the sense suggested by the notion of interobjectivity (shared meanings between objects constructed in interactions cf. intersubjectivity) and the actor-network-theory (ANT) (ref. [472][477]). It is an actor-like infrastructure close to the vision of *ambient intelligence* [1][308, 30], which leans on the idea of providing means to erect a dynamic system in which both human-beings and machines participate as actors. A fundamental notion in the context of the present study is that the system and its actors do not have to consist of merely *artificially* intelligent machines. On a very fundamental level, a virtual reality is a perceived state of being, which is immersed and interactive in a multidimensional context. This abstract notion of a virtual reality may be subsequently manifested in multi-sensory implementations, which incorporate, for instance, graphics, sound and haptic sensory information. The virtual reality application is an instancial representation of the abstract notion. The closeness of these instances to the represented knowledge structures and the subsequent *absence* of the virtual reality from the actual reality (ref. Section 3.2.1) depends on the faithfulness of the reproduction of relevant abstract dimensions, and subsequently, of the implementation of the aspects of presence, immersion and interaction.

Reflecting the ecological viewpoint of knowledge organisation, it is argued that the issue of the representational expressiveness versus richness of the expression might be addressed in the virtual realities using the concepts *contextual affordances* and *contextual constraints* as special instances of the ecology of knowledge organisation (see above, Section 3.1.5 on page 61). It is assumed that besides the manners of the knowledge organisation systems to *afford* and *constrain* knowledge formation, certain kinds of information and knowledge (not only the media) are inclined to emerge varying levels of immersion in different contexts, independent of the amount (i.e. breadth and depth) of the externally mediated information (cf. [734]). People feel impressed by the spectacularity of the animated computer graphics [267], which undoubtedly contributes to the subsequent immersion. The premiss for an immersive experience is not, however, *per se*, a rich multimodal media. The actuality of this characteristic is evidenced by the experiences of immersive, but informationally 'narrow' and 'shallow' semi-virtual realities such as text based chats or MUDs [687, 54-65][206], where the 'external' information stimulates the emergence of knowledge within the human actor causing a state of presence (or part of the 'vividness' in terms of Steuer, Section 3.2.2.4). Thus, the essential significance of the multiple modalities of information is in maximising the fit (i.e. the benefits of each media form in context), instead of perceiving the individual modalities (e.g. pictures, cf. the debate on the *picture superiority effect* e.g. [571][218], and also [288]), multimodality or multidimensionality ([762] cf. [177][178][176][179]) as independent values.

Besides the information, and the media and modality of communication, also the distinct infrastructural characteristics of the virtual realities afford and constrain the practise of knowledge organisation. As Ribarsky et al. urged already in 1994, the practical suitability of the virtual realities for the presentation and analysis of individual classes of data [618, 10] is not known well enough to allow any broad inferences like: "the virtual realities are good at communicating linguistic data". A virtual reality does not function like a collection of printed documents, a thesaurus or a conceptual model. Using a virtual reality as if it was another infrastructure,

is unlikely to result in an optimal knowledge organisation. The problems faced during the attempts to create workable textual indexing for non-textual materials illustrate well the essential difficulty of expressing atextual matters in a satisfactory textual form (e.g. [773][608], benefits of combined approaches see [417]). If a text-based approach is used, the text needs to be presented within the visualisation [618, 12]. Yet, due to the multimodality and multidimensionality of the virtual reality systems, the descriptions should also be expected to be capable of being given besides in text, also in speech or in other forms of media. Besides the description itself, also the *act* of description should be allowed by using various personalised modes of interaction [618, 12]. Considering the spectrum of the possible interactions in a virtual reality, it seems feasible to suggest that the essential characteristic of workable descriptions, is their functioning from within the infrastructure, instead of that they would lay attached, in a sense, on its 'surface'. Because the informative value of the virtual realities functions through the immersion, a knowledge organisation scheme, which is unable to fully mediate it, lacks clearly potential. It seems evident that in terms of knowledge organisation, a more virtual reality like approach is needed as Vatanen argues [797].

Among the non-textual materials, the images have been under the most profound scrutiny in the information science research. Layne argues that the images should be indexed according to their attributes and access should be provided not only to the individual images, but to the groupings based on the extracted attributes [478]. The notion may be arguably widened to grasp other information objects regardless of the medium (including the virtual reality information). The fundamental problem related to defining the attributes and presenting groupings based on them, is to determine, which attributes and groupings are 'useful' (cf. [478]).

The physical differences between the various media are fundamentally an issue of a diverging form. Besides the form, the question of providing fitting access points, is also an issue of function. Referring to the case example of music and art, Svenonius has pointed out the inadequacy of the subject descriptions in non-book, non-documentary contexts [756]. Even if a virtual reality would be used to document, for instance, an archaeological subject, the subject of the virtual reality is as difficult to express as it is in the case of the pictorial arts and music. It is conceivable to expect that each author and user of a virtual reality would construct an idea of its subject. Determining the subject, and especially expressing it in a relatively unambiguous manner is, however, extremely difficult. The multiple modalities of the interactions and the contextuality of the interpretations contribute to bringing the information systems closer to the everyday life modalities of the human communication. Concurrently the modalities do, however, lose their universal applicability.

Research in the multi-modal human-computer interfaces has promised more life-like interaction with the computer systems. The multi-modality is generally seen as a key feature of the future human communication with information systems [807][511]. The inherent problem of the multimodality is the concurrently increasing ambiguity. An image may well be a worth of a thousand words, but the problem is that the words may be different for each individual [267]. Communicating the essential message is difficult, because the message becomes interpreted in multiple manners even if the presentation would be constructed without inserting an exceeding amount of interfering data. This is a flaw, which has been rather typical in the graphic presentations inspired by the emerging possibilities of new computer systems [267]. The notion of the individual contexts applies, however, also in this context, because the clutter is not necessarily clutter for all.

The weakening of the shared and unambiguous in a virtual reality environment has already demonstrated acknowledgeable difficulties such as complications of evaluating the information, which is presented as seemingly realistic reconstructions and as more abstract visualisations of e.g. numeric data. Distinguishing the essential message, and a more trustworthy information from a less trustworthy one, becomes increasingly difficult. Special techniques such as the non-photorealistic rendering may be used to communicate the utterances and the opinions of the information creators [509][743]. It is important to provide these kinds of visual clues, but the act of provisioning does not address the broader problem of a 'virtual reality literacy'. Besides the visual clues, the knowledge organisation itself has to be able to communicate the authorities and the sources, which make the reliability judgements possible.

In conclusion, it is suggested that a knowledge organisation system, which implements multiple media forms and communicative modalities, such as the virtual realities, is from the information point of view principally dependent on the:

1. **Contextual constraints and affordances**: Different kinds of information support and create diverging degrees of immersion in distinct contexts, depending on the depth and breadth of the contacting surface between the context of information and of the user.

2. **Infrastructural factors**: The usability and relevance of information, which is in and about a virtual reality based knowledge organisation, presumes a match between the virtual reality and the infrastructure. Similarly as a paragraph of text may represent only partially the information presented in an image, an image of a virtual reality based knowledge structure may only partially represent the potential knowledge.

3. **Diverging forms and modalities of communication**: Multidimensionality and multiple forms of perception implemented in a virtual reality system are capable of supporting a broad spectrum of knowledge processes, but they do simultaneously increase the degree of perceived ambiguity and make the processes difficult to manage.

3.2.3.3 Knowledge organisation in virtual realities

The single most important premiss for using virtual realities as a knowledge organisation framework is to identify how a particular virtual reality based approach might solve some specific issues of organising knowledge. A major difficulty of using the notions of virtuality and virtual reality as pragmatic instruments of knowledge organisation and information management has been the lack of a solid theoretical understanding of the phenomenon addressed as virtual. It has been equally difficult to establish a functional meaning for the concept and the notion of virtual reality. Several attempts have been made to operationalise the concepts in various contexts. A general review of the propositions suggest the persistence of some of the problems. Pragmatic viewpoints tend to produce workable solutions, but within a rather limited scope of application. On the other hand, the theoretically more ambitious approaches only rarely reach a level of a strong practical applicability.

The present study sees the potential of a virtual reality based knowledge organisation conditional on several factors, which are summarised in the following:

First, even though the virtual realities do share many essential characteristics with other knowledge organisation systems, **1) a virtual reality is not a 'traditional' system of organising and managing information**. The virtual reality form induces a need to examine the fundamentals of knowledge organisation in a new light. Virtual reality binds the information structures to follow more closely the contextual structures of its users, both organisations and individuals. In the virtual realities, knowledge and information do not reside in similarly structured and formalised entities as they do in a thesaurus or in a library catalogue. Knowledge is not an external or a semi-external entity, and the knowledge organisation system is not a surrogate. Information and 'information-on-information' are both embedded in the same system. Information and knowledge are not distributed centrally within the system through a hub, but they are fundamentally available everywhere within its confines. Finally, even the assumption that knowledge and information would be textual or visual, or even necessarily possible to be described textually, have to be discarded in the context of virtual realities.

The dynamics of knowledge organisation in a virtual reality context may be taken to suggest a paradigmatic shift from a 'traditional' knowledge organisation towards the management of organised knowledge (cf. with [450]) in context. Knowledge is structured and organised also in a virtual reality environment, but it is suggested that the the environment necessitates a dynamic management of a fluid synthesis and an emergence of knowledge states, as parts of a systemic process, rather than administering an essentially static externalisable asset or a thing (ref. Section 2.4.1 and [585]). The notion brings together the paradigmatic approaches of knowledge management and information management through underlining the role of information as a premiss for an effective functioning of knowledge in human work. As Streatfield and Wilson observe, knowledge becomes managed through an effective management of information [742]. Another aspect of the management of knowledge, which is emphasised by Broadbent, is the role of the implications of the management practises as a contributor to the organisational effectiveness and value [117, 24]. Remarks on typical knowledge management failures put forward by Davenport, also apply to the practise of knowledge organisation as a part of the comprehensive process of controlling information related work. Davenport observes concerning knowledge management that the knowledge issues are not addressed by concentrating on the technology or software, simplifications of knowledge such as best practises, benchmarks and information resources, access possibilities, or by omitting the recruitment of knowledge specialists and the political nature of the entire notion of its management. Knowledge issues are addressed by actually focussing on the knowledge itself [215][212].

Secondly, **2) the practises of the virtual reality based approaches in knowledge organisation and information work management, are waiting to be developed**. The current status of the information rich virtual reality applications is experimental, and in spite of some prominent installations in production contexts, their role is still mostly exploratory. A careful analysis of a selection of the already published projects combined with a more indepth information gathered in field experiments and in the interviews related to the present study, provide a functional basis for establishing a model, which describes the general dynamics of information and knowledge in the virtual reality contexts. The model carries a special reference to the context of archaeology and cultural heritage on the level of references and experiences, but also addresses the broader issue of using the virtual realities as knowledge organisation systems independent of the context. The proposed model

is discussed in detail in section 9 and illustrated in figure 9.1.

Third, as opposed to the abstract information work, an evident **3) benefit of the virtual reality simulations and the provision of presence in distance (telepresence) concerns information rich tasks, which require personal participation**. Such activities are exemplary of an even more unstructured and unpredictable work than the office work, which was studied by Strassmann and declared to be challenging to support with the help of information technology [738, 21]. Virtual realities have been suggested to be effective in technical teleoperation-like tasks, which require coordinated control of a viewing, such as in laparoscopic surgery, and in operating remote indirectly controlled systems [251] (cf. however [10]). Maurin has studied potential cooperation performance of paramedicals and medical doctors in emergency situations, where the scene of action would be presenced from the field to a hospital by using virtual reality equipment [514]. Compared, for instance, to a video and audio communication, the benefit of virtual presencing is its multimodality and better mediation of dimensions, and the diminishing of the effects of cognitive delays and awkward placement of cameras [251]. The systems, which lay virtual elements on top of the physical surroundings of the users known as augmented realities, take the presencing to a local level. Feiner et al. [264] developed an experimental system for laser printer maintenance and proposed several comparable knowledge based systems with the purpose of helping and training users to perform tasks in local contexts. Augmented reality systems have been used also in medicine, military contexts, robotics, entertainment, and real-world annotation and documentation tasks [47] already in the 1990's.

Fourth, even if the notion of virtual reality has proven to be auspicious in several contexts, **4) the issues of technical and intelligible complexity and subsequent ambiguity, costs and time constraints, limit the general usability of the virtual reality based knowledge organisation systems**. As Stary notes (referring to the technology dimension), it is important that a virtual reality system contributes to the overall effectiveness of work, not only on one of its individual components [724]. Introducing a virtual reality framework in archaeological, or in any other type of information processing and management, is hardly worth the trouble if the expectable benefits remain dubious or relatively small. Technical training of the users and purchasing a required set of equipment is likely be too costly in most instances. Managing the inevitable resistance against alterations may also be considered to be too difficult and costly as Shelbourn et al. [685, 48-49] suggest. Besides the technical and organisatory issues, the fundamentally exploratory mode of operation related to virtual realities makes them unfeasible for many routine tasks. Less sophisticated information structures, uncomplicated methods of knowledge organisation and direct access to the information are likely to be more productive approaches in many instances than a complicated virtual reality might ever be. It is important, however, not to underestimate any particular piece of work as a 'routine work' without a careful analysis of the process, because the instances of complex information work exist embedded and hidden in many straightforward looking work flows [99].

Virtual realities have been criticised of failing their fundamental promises. The evidence gathered on the effects of presence on the task performance is controversial, as Schuemie et al. [670, 188] conclude. Similarly the expected benefits of the three-dimensional versus two-dimensional user interfaces have been mostly negative ([762] cf. [177][178][176][179]). The critical studies deserve, however, some closer attention. Most of the research configurations have attempted to make direct

comparisons between physical settings and virtual settings by examining leadership in different kinds of virtual environments [728] or by comparing basically alike two-dimensional user interfaces to the three-dimensional ones [177][178][176][179]. The constituent problem with the described configurations is in the implicit suggestion that the dimensionality, interactivity, or the sense of immersion, should be universally beneficial in diverse tasks. Quite the contrary, the use of the virtual realities has been frequently noted to become plausible only while working with something, which is otherwise unattainable. Information may be unperceivable for the human senses like the signal transmitted by sonar, it may be lacking a perceivable form, such as population dynamics [843], or it might be only partially available, similar to the information about past cultures. Virtual reality may thus function as a transducer, reificator or an assemblage, in providing a sense of hyperperception.

Besides the apparent failures, the immersion, interactivity and dimensionality have shown considerable promise in specific settings. For instance, a virtual reality based psychological therapy has proved to be highly effective [641]. Schuemie et al. conclude [670] that the success relates closely to the sense of presence attainable within the virtual reality system. A plausible explanation of the importance of the presence may be deduced by examining a real-world therapy setting. Presence is not merely present in the situation, but constitutes a factor of a primary importance. It is possible to solve a puzzle with a set of semi-appropriate controls from a distance. Becoming psychically affected without a real possibility of becoming affected is, on the contrary, quite impossible.

Fifth, **5) the virtual reality has to serve an explicit purpose in a knowledge organisation system**. It is plausible only for the specific settings, which constitute of dimensionality and explicitly require engagement and interactivity. The present study argues that the functional characteristics of the constituent qualities of the virtual realities: immersion, interactivity and dimensionality resemble closely the observations made on the functionality of the contexts and situatedness of the human information interactions. Considering the discussed virtual reality applications, it seems plausible to suggest that **6) the effectiveness of the successful virtual reality implementations lies, broadly speaking, in the enhanced capability of constructing and reconstructing multimodal and multidimensional situations, where users may interact and sense presence**. As Ryan remarks on a hypertext, also a virtual reality is capable of bringing together the heterogeneous and break apart elements, which are traditionally considered to belong together [650, 7]. The effectiveness of a flight simulator and a historic reconstruction resides in the (re)creation and simulation of a quasi-authentic situation. The sensed presence does not function only in conjunction with the physical availability of manipulation. The effects of the situatedness have been demonstrated also on a perceptive level. Steels [729] refers to an episode, during which an expert was unable to solve a problem on the telephone, but could instantly find a solution, when he arrived at the location. Comparable importance of the situatedness has been observed in the work of architects. Stellingwerff has described the effect as "sensing the *genius loci*" [731, 256]. As he argues, the virtual presencing is not necessarily capable of replacing the actual experience. A virtually created context was demonstrated, however, to be capable of providing a sense of situatedness for the architects, as previous studies have suggested in other contexts in diverse fields (e.g. [641]).

In summary, the experiences so far seem to indicate the possibility of being able to provide effective situations for information work in virtual realities. Therefore, it is proposed that **the basis of a successful virtual reality based knowledge organi-**

sation in the context of information work management, lies in the identification of the specific instances of activity, where the information work involves complexity, benefits of close situatedness, illinear organisation, mediated physicality and the multimodality and multidimensionality of expression. The present virtual reality implementations and their use contexts indicate that a success story typically involves learning, creativity and innovation coupled together in contextually and contentually complex situations. A virtual reality based knowledge organisation may be used to create a situation and a context for the intellectual activity of information work. The point is not in modelling precisely the actual conditions, but in providing tools for a creative knowledge construction.

3.3 Summary

The present chapter constitutes a viewpoint of the virtual realities as potential systems of knowledge organisation. The notions of *knowledge organisation*, *knowledge organisation systems* and the premises of establishing working infrastructures for the knowledge organisation activity are discussed within the framework formed by the *ecological viewpoint* and the concept of *warrants*.

The second part of the chapter outlines the concepts *virtual* and *virtual reality* and explicates the premises of using them as a conceptual basis for explicating the premises for developing a virtual reality based framework of knowledge organisation. The principal characteristic of the virtuality is considered to be in *non-actuality*. The factors, which constitute a virtual reality are considered to be *engagement*, *interaction* and *dimensionality*. It is argued that a functional virtual reality based knowledge organisation system needs to implement these three elements to be effective and feasible in comparison to the competing frameworks. Finally the last section of the chapter outlines premises for a successful virtual reality based knowledge organisation in information work contexts and underlines the significance of their tight integration. The constituent condition of adapting a virtual reality based approach to the organisation of knowledge is the acknowledgement of the specific characteristics of that framework and a careful consideration its feasibility.

Part II

Empirical study

Chapter 4

Material

4.1 Data collection

The empirical data used in the present study was collected by using an adapted version of a semi-structured approach referred as *thematic interview* [372, 35-37][1]. The assumed approach combined several different forms of semi-structured inquiry within the general framework of the particular method. The discussion on the different interview themes was informed and structured according to the notions of freeform thematic discussion and storytelling in the spirit of 'creative interviewing' (theme 2, [236][279], for themes ref. Section 4.5), active semi-structured interview with an objective of inducing structured reflection in order to inform the interviewer (theme 4, [388], reflection ref. [107, 37 Fig. 3]), semi-structured interview (themes 1, 3, 5, 7 and 8 ref. [279]), and an imagination exercise (theme 9, [675, 177][2]). In spite of the relatively precise explication of individual questions, the interview guide (Appendix B) was used as a directive instrument and memory aid instead of as a precise structuring device (ref. [372, 41-43]). The interview material was complemented with an indepth study of literature.

The motivation for adopting the present approach was based on the nature of the research frame:

1. The research questions presume a holistic understanding of the diverse information work processes, which is impossible to obtain by using a survey or a comparable prestructured approach [223, 9–10][372, 15].

2. The intent to discuss the issues on a level of a profession presumes a relatively large and extensive sample of informants from different institutions and countries. The size and geographical distribution of the group of informants rendered the more time-consuming methods, such as observation, impossible.

3. The informants were assumed to be experts in their own field and thus being well capable of explicating the processes, priorities, problems, motivations

[1] The method is based on the "focused interview" of Merton, Fiske and Kendall (ref. [372, 35-37]).

[2] The imagination exercise was conducted as an oral narrative instead of a written one due to the length of the interview and because in the light of the pilot interview, it seemed that the oral narrative might lead to the capturing of more utterances and a more uninhibited flow of imagination in contrast to a written text.

and objectives of the archaeological work (ref. [224][141]). Therefore the observation was not considered to be obligatory.

Several researchers recommend the use of multiple data gathering methods in order to broaden the perspective and to gain deeper understanding of the subject of the study (e.g. [397][708, 451-452][115]). The approach of combining several data gathering methods, data sources or theoretical viewpoints is commonly referred to as *triangulation* [222] [416][223][127] (in information science context ref. e.g. [258][397][268]).[3] A genuine method of triangulation (i.e. complementing the interview material with a series of e.g. quantitative studies, cf. [127]) was considered to be too costly and to cause extensive problems with the epistemological consistency of the data within the context of the present study (ref. [96]). The process of using several thematic interview methods complemented with semi-autonomous exercises subscribes, however, to the rationale of triangulation by assuming a constituent variation of assumed perspectives between the interview themes (ref. Section 4.5).

Like a genuine methodological triangulation of data and data gathering methods, the assumed multi-viewpoint approach to the thematical interviewing, is not a method of validating the results [223]. The method provided, however, a way to approach the informants, their knowledge and viewpoints from different angles, and allowed comparisons across the personal and professional, and the user, contributor and participant perspectives to the information and work. The objective was to induce a "cacophony" of viewpoints instead of pursuing to a single explanation (ref. [274, 119]). The combination of free-form and structured sessions made it possible to acquire information from the informants irrespective of their personal characteristics. Furthermore, the method gave an option to make qualitative cross-evaluation of the responses between the individual themes.

4.2 Informants

The group of informants consisted of 25 archaeology professionals from Finland (12) and from Sweden (13). Thirteen (13) of the interviewed were male and twelve (12) female. Limiting the study to the archaeology professionals left out amateur-archaeologists and cultural heritage professionals without principal archaeological education or predominantly archaeology-related duties. To preserve their anonymity, the informants are cited throughout the study by using codes. Each of the 25 individuals were assigned a random letter between A and Z, which is written inside brackets in citations and references.[4]

Informants were not asked to indicate their absolute age, but instead to describe the duration of their involvement in archaeology. Indications were subjective. Usually the interviewees calculated their involvement from the beginning of their studies or from the first actual archaeological job. The figures were normalised to comprise an average 7 years of studies whenever the actual length was not precisely

[3]The critique of triangulation has been focussed on the occasional epistemological incompatibility of different data gathering methods [96], convergence of triangulation and the research objectives [412, 391-392], and the practical shortcomings of many research designs [127].

[4]The personal pronouns used of all informants, both male and female, are in feminine throughout the text. Because of the qualitative and indicative nature of the empirical material, the textual references to the number of informants is indicated primarily in a relative scale: 'none', 'couple', 'several', 'most', 'nearly all' and 'all' instead of giving exact figures (e.g. 3 out of 25). In comparison to the evidence, the approach represents a comparable and thus relevant scale of precision.

given by the informant. Distribution is relatively even the mean value being 17,5 years. Minimum indicated duration was seven (7) years and maximum 43 years giving the range of 36, which is relatively close to the possible maximum of still active professionals.

A large proportion of the interviewees indicated that they did not originally enrol at a university to study archaeology, but other subjects (folklore, psychology, construction engineering, history, Latin, art history, naval engineering). According to the information given, all except one of the informants had archaeology as a major subject.

Popularity of the minor subjects varied considerably. The most popular choices were ethnology, classical archaeology (which was considered according to the material as a minor subject, because all of the informants indicated it as such), history and art history. Choice of minors was expectable considering the subjects available and apparently recommended at the different Finnish and Swedish universities. Two distinct, yet partially overlapping groups seem to exist: one oriented towards natural sciences (with minors such as geology and biology) and another with strong humanities orientation (history, art history, ethnology etc.).

The question of present professional duties was deliberately left open to let the interviewees describe freely their professional activities. Diversity of the duties seems to be a commonplace. University affiliates were mostly involved in research, administration and teaching with exception of the two full time graduate students. Museum affiliates worked both with services and in collection management. The group of museum affiliated informants (cf. [512]) did not comprise a dedicated museum information specialist, although the profiles did grasp frequent implicit information management related tasks. Those, who were affiliated with administrative governmental bodies were involved in a number of support, administrative and practical operational duties. The body of the interviewees included three project workers, who were mostly involved in fieldwork without a permanent position. This is according to the interviews, and also otherwise generally known to be the most typical condition for a recent graduate in archaeology. The most common individual profiles involved administration, research and fieldwork related duties.

Practically all of the interviewees had earlier fieldwork experience worth mentioning, mostly from an earlier career as a project worker. Museum related work experience, such as guiding and serving in other practical museum related duties, was another commonplace. Some of the interviewees had only a little work experience from an earlier career, because they were still working in their first proper job or had worked earlier only in duties, which resembled their present work profile. Tendency to change the employment was significantly low among the informants who had permanent positions, which effectively indicates the difficult employment conditions and scarcity of available jobs.

4.3 Sampling

The method, which was used to select the informants, was based on theoretical sampling [320]. The approach is typically used for selecting theoretically representative small scale samples in qualitative research. The notion of theoretical representativeness should be understood in this context as a confirmation of the presence of a relative heterogeneity in the sample. The theory used in the sampling was based on the following determining factors in the order of their estimated importance:

1. Nationality
2. Focus of present professional duties
3. Focussed archaeological topic(s) according to chronological, methodological and thematic distribution of interests and duties
4. Type of institutional affiliation
5. Alma mater i.e. the university or universities where the informant had studied
6. Current geographical location of employment
7. Sex

The choice of the factors was based on the researcher's previous knowledge and a preliminary study of the archaeology profession in the two countries. The factors were chosen in order to be relatively easy to control, yet at the same time capable of providing a necessary variation within the group of informants

Sampling according to the nationality was straightforward to implement on a maximum 50%+/-10% basis. The professional duties based distribution was established to include the following categories of primary occupation:

1. University teachers and researchers
2. Museum workers
3. Archaeological heritage administrators
4. Field archaeologists

The selection of the archaeological topics was based on the methodological literature and the expressed foci of the selected institutions, which employ and educate archaeologists.[5] The descriptions were retrieved from the institutional web pages. The focus was set on the primary research and professional interests, and the university course descriptions. According to the survey of the topics, the inclusion of the representatives from each of the following categories was ensured during the sampling process:

1. Chronological: prehistorical, classical and historical archaeology
2. Geographical: European and extra-European archaeology
3. Environmental: Land and underwater archaeology
4. Approach: Field archaeology, theoretical archaeology and experimental archaeology
5. Methodological: artefact studies, building archaeology, scientific, processualism and post-processualism oriented approaches

[5]The bibliometric study of Swedish archaeology (a master's thesis) conducted by Asplund came to highly similar conclusions on the clustering of the archaeological field. The principal factors were chronology, theoretical/methodological approach and (to a degree) geography [42, 50, 58-59 and 69].

As the interviews were conducted according to the thematic approach, neither a quantitative distribution nor the inclusion of the topics was constrained. Another important point is that because none of the informants could be considered as a pure representative of any of the topics, the selection functions only at a representational level and not as a definite survey of all different archaeologies.

The typical distribution of the institutional affiliations and the professional duties was studied by examining two recent overviews of the employment of archaeologists in Finland [451] and in Sweden [37] respectively. Results were controlled by comparing the results with a comprehensive study from Britain [11]. Complementary spot checks were made also with Google in the World Wide Web by searching with keywords "arkeolog", "antikvarie", "arkeologi" and "arkeologia" for obvious anomalies. The adopted institutional distribution constraint presumed the inclusion of the following categories:

1. Three different universities (in Finland all three universities with archaeology departments: Helsinki, Turku and Oulu; in Sweden universities of Stockholm, Uppsala and Lund)
2. National administrative bodies (National Board of Antiquities in Finland and National Heritage Board in Sweden)
3. Provincial museums and local museums
4. Maritime museums
5. Archaeologists working on a project basis for different institutions

Distribution of the informants among the different universities was controlled by studying the publicly available affiliation and publication history of potential informants. The aim was to ascertain that several universities were represented in the sample in order to correct a potential bias caused by an identical education background.

Geographical distribution of the informants was secured according to a criteria of selecting at most two thirds of all informants in each of the countries working in one locality. Similar to the nationality, the sampling according to the sex was straightforward to implement on the comparable maximum 50%+/-10% basis.

4.4 Recruiting

Informants were recruited personally by using two standard letters of invitation (Appendix A) sent by email. Informants acted on a voluntary basis. The original letter was written in Finnish and used to recruit the informants in Finland. For recruiting informants from Sweden, the letter was translated and edited in some detail to motivate addressees to participate in the research project. It was estimated beforehand that recruiting from Sweden would be more difficult than from Finland. Motivation to participate in a study conducted by a foreign researcher was considered to be potentially lower.

The rate and the speed of the favourable responses from Finland was significantly high. With an exception of one informant, all attempted contacts resulted in a reply. Of the responding contacts, only one rejected participation. All responses arrived within one or two days after the invitation. The ratio of attempted contacts versus conducted interviews was 14 to 12 (86%).

The situation was considerably more problematic regarding the Swedish informants. Of the candidates contacted, 14 did not respond at all. Two candidates rejected participation after the first contact although they decided to participate after an additional contact. One candidate declined the request definitely. With two persons approached, no suitable date for the interview could be established and with one, after an initially positive response, the email contact was unfortunately lost. Establishing a contact, calculated as the time from sending the initial email to the first response, took from a few hours to almost a month. Altogether 32 potential informants were contacted of which 13 were finally interviewed (41%).

The choice of resorting to the use of email in recruiting the informants was decided by the speed, unintrusiveness and flexibility of the method. Gaining the confidence of the informants was considered to be the first priority. An email was estimated to give them reasonably detailed background information and a possibility of consulting the message as thoroughly and as long as they wished. Furthermore, an email invitation is easier to discard than to refuse an interview in a telephone conversation. By using an email, it was also possible to ensure that all the informants were given precisely the same background information, which may be expected to increase the comparability of the interviews due to the similarity of the informants' preliminary knowledge. Sending an email is also faster and more economical than sending a letter and finally, the replying was considered to be significantly easier, which was expected to decrease the number of non-reacting respondents.

The reasons for the uneven outcome of recruiting in the two countries may be speculated on only rather generally. The initial expectations of the informants were likely to have some effect. Despite the explicitly opposite emphasis, the letters of request made some of those approached to think that the research was focussed on the information work in digital environment and thus required of them some specific skills or experiences in archaeological computing. The assumption was reflected in one declination (the only Finnish one) and in the positive responses where the informants warned beforehand that they were not experts in information systems or computer use. The typicality of this assumption might suggest that some of the non-respondents might have ignored the request for similar reasons.

Even though the interviews were explicitly stated to be held anonymous, knowledge of the interviews taking place was spread in a matter of days. A number of informants noted that they had discussed with their colleagues and were well aware of others being interviewed as well. The overall effects of the social networking is discussed in more detail in section 7.1.9. It seems plausible to assume that the patterns and functioning of the grapevine in Finland had a considerable effect on the recruiting process. Earlier contacts between the researcher and archaeologists either involved or known by the involved were likely to facilitate the process in Finland in comparison to Sweden, where no comparable contacts existed.

Finally, some technical considerations might have affected the results. The periods of recruitment, from the early April to August in Finland, and from the late September to late October in Sweden, might have had some minor effect, even if it is not easy to prove. The individual habits of reading email and reacting to the messages were likely to have a noteworthy effect to the recruitment. In the present flood of email messages, it is possible that some of the invitations were removed accidentally by anti-spam or anti-virus filtering. Similarly, the potential informants might have deleted the requests either by mistake or on purpose as an unwanted litter. As a whole, the recruiting process was, however, successful, proved effective,

produced workable results and avoided some of the notable problems relating to the email-based recruitment, which have been reported earlier.[6]

4.5 Data gathering

All interview data was gathered in individual thematic sessions conducted in person by the author. The locations of the interviews were chosen by the interviewees, although the interviewer suggested choosing a convenient undisturbed location and volunteered to travel to the study or the workroom of the informants. Possibility to arrive for the interview to the Department of Information Studies at the Åbo Akademi University in Turku was offered if asked, but not specifically recommended. The informants were expected to be feeling more confident and thus to be more informative in their own familiar environments. Another benefit of working in the vicinity of informants' offices was the possibility to make references to the on-going activities, projects, literature or other material, which was available on the spot. Finally, the interviewer could contextualise the informant more easily in her own environment and get cues for free form follow-up questions during the interview.

Thirteen (13) of the interviews were conducted in the informants' private office, seven (7) in a coffee room or meeting room, three (3) in an office shared by several persons, and one (1) at the informant's home. None of the interviews were disturbed by frequent interruptions.

Time and date of each interview was decided by the informants usually following a suggestion made by the interviewer. Typical points of time were in the morning at around 9 am and in the afternoon at 1 pm. One interview was conducted in two sessions 12 days apart from each other due to the scheduling problems. Despite the different layout of the session, the material does not differ substantially from the rest of the interviews conducted without stopping.

Interviews took place in Finland from the end of February to mid-September 2004 and in Sweden during the same year from early October to early November. Interview scheme was tested in one pilot interview, but because no radical changes were necessary, the interview guide was left intact and the pilot interview accepted as a primary research material. A typical interview took 150 minutes. The shortest lasted 105 minutes and the two longest 180 minutes. The length of the interviews was not apparently an issue for the informants. The approximate duration was given already in the invitation. None refused explicitly due to the expected length of the interview, nor did the informants make complaints that the sessions were too long. On the contrary, the informants who did beforehand express some reservations on their availability, explicitly stated during the discussion that the interviewer was free to exceed the agreed duration. The validity of the general observation that people tend to be eager to tell about their own work was clearly reasserted in the discussions.

Interviews were conducted as thematically structured conversations. The theoretical basis of the interview varied between themes and drew from the inquiry

[6] For their online and phone survey of college and university students and faculty for the Sense-Making the Information Confluence Project (http://imlsosuoclcproject.jcomm.ohio-state.edu/), Principal Investigator Dervin reported in personal communication that it took email correspondence with 44,028 unique email addresses to successfully enlist 409 informants to complete a 20 minute on average online survey and a 76 minute on average follow up phone survey. This was an average of 107.6 unique contacts per final informant or a response rate of 0.93%. This count does not include follow-up email and phone contacts which are yet to be tallied [225].

methods discussed in section 4.1. A special focus was placed on discussing in a free descriptive manner the different aspects of information work, work practises and the conceptions of the informant. Conversation was guided by a structure, which is explicated in the interview guide (Appendix Section B), but the basic intention was to use the scheme as a device of ascertaining the coverage of all constituent issues, not as a definite rule. The interview guide was used solely by the interviewer although its existence was not hidden from the subjects. The advantage of the chosen method was the possibility to gather comparable data, but at the same time emphasise the constituent topics of each individual context. The conversational method was chosen to erect and nurture trust between the interviewer and the interviewee (ref. typical problems [279, 655-656]). The method provided also means to reduce the interviewer effect with respect to the style and approach of discussion. The interviewer could act more encouragingly with reserved interviewees and to guide the more extrovert informants to concentrate to the subject of the interview [273, 145]. The 'creative' freeform orientation of the approach enabled the interviews to penetrate to the attitudes, experiences and emotions related to the work activities (ref. unstructured interviews [236][279]. The conversations were focussed on stories and personal experiences instead of direct questions as Snowden recommends [701, 2]. According to him, the direct questions are unlikely to result in voluntary sharing of knowledge, because of a lack of a real need or a social obligation between the interviewer and the informants [701, 2].

All interviews were taped and converted to digital audio files. The interviewer transcribed a structured draft of each interview by using Transana versions (1.24 and 2.x for Windows) and Transcriber (version 1.2.6. for MacOS X) software.[7] The technical quality of the recordings was satisfactory. Besides recording the discussions, the interviewer made written remarks on the interview guide keeping, however, the writing to the minimum in order to maintain a discussion-like atmosphere. The written comments were used as transcription aids, and in the inclusion of the non-verbal modalities of communication and interaction to increase the reliability of the data [582, 203-205]. To increase the reliability of the data, the interviewer was explicit also about the 'intercorder' communication (i.e. between interviewer and recorder [521]), and thus e.g. in course of the discussion explained aloud equivocal references to items pointed out by the interviewee.

Interviews consisted of nine (9) individual themes (ref. Interview guide in Appendix B):

1. *Demographic*. The interview was started consciously with a set of concrete questions, which were formulated to be easy to answer. The aim of the theme was to gather factual general information about the informant, her professional background, work and research experience, education and self-perceived positioning within the archaeological community. The obtained information was used directly to determine the contentual priorities and formulation of the interview. The final aim of the discussion was to build trust between the informant and the interviewer, and thus to encourage free expression following the principles of 'cultural interview' [645, 10].

2. *Information work*. The second theme had the most free form of them all. Informants were encouraged to tell freely about their work and the eventual information related activities, interactions and behaviour. The obtained information was supplemented by a set of standard questions on information creation, dissemination

[7] A Macintosh version of the Transana software became available only after the transcription was completed.

of information and information seeking behaviour to complement the free form description. The overall aim was to establish a general idea of the individuals' information activity and to get at the same time deep insights on the central issues concerning her information work.

3. *Information source use and perception*. This section covered an overview of the information source use of the informant as a complementary theme to cover the sources left without a mention during the previous theme. The emphasis was placed on the frequency, utility and affective usefulness of each media in the professional activities of the informant.

4. *Information creation case-study*. This section consisted of a discussion on an 'information object'[8] created or co-created by the informant. Aim of the discussion was to reflect on a concrete example of the information work procedures discussed earlier on a more general level in the theme number 2. Partly the discussion was to verify the analytic representativeness of the described activities and to replenish the description with an information need oriented approach.

5. *Interaction with the past*. The theme was used to determine the attitudes, motivations, conceptions and views on archaeology, archaeological work and the past in order to contextualise the descriptions of the information activity.

6. *Spatial ability*. The theme was used to trigger comments on the self-perception of the eventual spatial, visual or other perceptual orientation of the interviewee to gather contextual cues for the premises of information source use, choice of media and the reactions to the various presentation techniques.

7. *Computers*. The computer use theme was used to gather material on the computer use, self-perception of the information systems use and the general disposition towards the current and forthcoming computer applications in archaeology.

8. *Virtual, multidimensional and graphic (re)presentations*. The second last theme consisted of questions, which related to the notions of virtuality, and the spatial and multi-dimensional representation of archaeological objects and subjects. The discussion was used to estimate the subjective meanings of the notions, the understanding of the related concepts, and to trigger utterances and expectations related to the new technologies and environments in the context of archaeology.

9. *Imagination exercise*. The exercise was used to complement the interview and to provide material for cross-methodological comparison. Imagination method was used to facilitate the informants to find out impressions about their current work situation, and to imagine and express their needs and wishes regarding the archaeological work and its future.

The different themes have provided material for the various analyses throughout the study. The relevant themes are mentioned in conjunction with the analytical discussion. It is necessary to emphasise, however, that the interviews were based on a continuous triangulatory cycle, where the relevant topics were discussed whenever they emerged during the discussion. The relevant information may have also been disclosed during the different phases of discussion with the different informants. Therefore the pointers to the various themes need to be considered as merely indicative.

[8] The term 'information object' is used in similar meaning than in [398] (for definition see [398, 19]) to address both the sources of information and the information objects being produced.

4.6 Limitations

The most considerable limitation of the gathered material is the lack of general representativity. The theoretical sampling method results in a group of informants, which is analytically valid in a context, but lacks a definite tenability in general terms. The sample is simultaneously both consolidated and biassed by the used theory. Therefore the results are capable of showing tendencies, which are of an analytic importance, but may not be used to derive conclusions in an analogous manner about any larger population within or outside the scope of archaeology. With a specific reference to the international discussions on the archaeological information management, it is especially important to note that the constituent differences between the two Nordic countries are relatively minimal in the global scale.

Besides the general remark on the representativity related to the qualitative nature of the study, some overall observations are necessary to assess the limitations of this particular corpus of material. In spite of the basically successful measures to control the geographical variable, the distribution of the informants is concentrated primarily to the southern parts of Finland and Sweden. The reason for the emphasis is practical and relates to the economy of work in the gathering of the research material.

Besides the southern parts of the two countries, also the middle-sized to large public institutions are over-represented in the sample, while the small local archaeological actors are under-represented. Of the professional groups, the commercial archaeological operators are altogether absent from the interview material. Commercial contract archaeology is a relatively small branch of business both in Finland [426] and in Sweden [579, 54]. Currently planned reforms in Sweden are likely to open up the archaeological operations for a wider concurrence [626][579][583][419], but because the activity itself remains closely regulated, it may be assumed that the promotion of competition is likely to have only limited effects on the constituent information work related practises. In the present study, the limited bias concerning the priorities of information work caused by the absence of commercial operators, is partly compensated by first-hand observations made by the author.[9] Considering the observations of the author, it seems plausible to expect that the present findings express a somewhat lower weighing of economic issues, importance of added value and considerations of efficiency and minimum requirements of the archaeological investigation projects (ref. also [426]). Similarly, the importance of the standardisation of the reporting and the work processes might have received a slightly pronounced emphasis in the opinions of the commercial operators.

The last, somewhat, tentative bias of the material relates to the attitudes of the informants. The responses to the invitations, which were received during the recruitment process, gave some indication that the informants might be slightly more interested and positively disposed towards the computer applications and information management issues than an average archaeologist. The attitude was not, however, reflected in the perceivable computer or information systems literacy, information management related experience, or in the uncritical tones of the opinions of the informants.

[9] The author of the present study has been working with archaeologists in various projects since 1998.

4.7 Remarks on the method of gathering data

The general criticism of semi-structured thematic interviews, ethnographic approaches and user studies applies largely to the method used in the present study (ref. [279, 654-656], for implications ref. [834][376]). The most typical problems of the method including the difficulties of attaining access to the information, gaining the confidence of the informants, the time consumption, and the dependence on the recall function instead of recognition (e.g. [711, 67][279, 654-656]) constrained also the present effort. In spite of the presence of some apparent issues, there is no apparent reason to question the overall reliability of the data (ref. [582, 203-205]).

Following the trustworthiness criteria established by Lincoln and Guba [491, 301-327], the data gathering method comprised techniques of ensuring credibility, transferability, dependability and confirmability. Even though the interviews themselves were relatively short, the preliminary literature study and interviewer's previous knowledge on archaeology gave perspective to the data gathering and analysis. Similarly, the triangulatory variation of interview approaches provided credibility to the investigation. The requirement of anonymity restricts the possible thickness of the descriptions and the auditing of the results, because the research context is relatively small and the level of inquiry is very detailed [491, 316-321].

Due to the special conditions of this study, some of the typical objects of criticism are more significant than the others. The access and confidence issues were relatively minor considering the scope and the detail of the interviews. The informedness of the author about the subject field of the study was a definite advantage. The negative effect of 'assuming too much', which comes easily with the informedness of the interviewer, was controlled by being specific about asking the informants to elaborate on all significant issues. An occasional initial tendency to satisfice the interviewer was observed in the discussion relating to the themes 3 (information source use), 7 (computer use) and 8 (virtual realities). This bias was controlled by introductory remarks of the interviewer about the non-existence of a 'proper code of conduct' or a minimum level of competence. Furthermore, in the assumed cases of satisficing, the interviewer attempted to remedy it by shifting the discussion to concrete examples.

The conversational method (ref. Section 4.5) allowed the interviewer to adapt his behaviour and the style of the interview according to the informant (ref. [273, 145]). Because there was only one interviewer, any personal or social interviewer effects were difficult to control and remedy. The basically comparable (educational) background of the interviewer and the interviewees might be expected, however, to reduce the significance of the very basic social issues (ref. [273, 144-145]). On the other hand, the absence of multiple interviewers means that there are no inter-interviewer reliability issues.

The most significant complication of the data gathering process touched upon the general conceptual problems of discussing about information. Conceptualising activities as information processing is not natural to the human-beings, which complicates the eventual use of any direct data gathering method (ref. [844]). The interview design attempted to manage the issues of discussing information related activities through adopting a scheme of indirect and contextual questions and a special emphasis on encouraging the informants to tell stories and contextualised anecdotes. Despite this largely successful approach, the attempted information science perspective caused occasional complexities. Interviewer had to explicate rationality of some questions and to use relatively long introductory explanations in

the contextual questions to reach some specific pieces of information.

The explicit questions, which concerned information and information sources, were generally out of the context of the informants. The first two sections of the interview (ref. Appendix Section B) did deliberately omit an explicit definition of the concept 'information'. The invisibility of the information concept was important to get as unbiassed view of the practical (information related) work as possible. The introduction of the concept 'information source' in the third section of the interview triggered a process of self-definition of the concept of information in all interviews. The processes commenced in significantly dissimilar manners. The individual informants did, however, tend to attempt to adapt to the assumed viewpoint of the interviewer. This tendency was clearly biassing the explicit statements made about the information sources and information activity during the later parts of the interview. The observations made during the interviews seem to suggest that an even more pronounced emphasis on the conceptual clarity would be beneficial in the interview design in order to avoid unwanted assumptions about concepts and their meanings. In that respect, any interview questions, which carry some explicit references to the information science concepts (e.g. [711, 70, 85-86]), are problematic and are about to lose their potential in attaining an understanding the informant in her personal context. One further danger of the conceptual assumptions is an unintentional emphasis of the intentional information activity instead of a broader focus on capturing both the explicit information seeking and the more implicit information discovery [706].

The final remark concerning the material gathering process relates to the observed difficulty of producing graphic representations of the information and work related issues. Many projects have reported successful implementations of getting the informants to produce graphic maps of the information horizons, work organisation and comparable structure-related issues (e.g.[711][520]). In the present study, the informants who seemed to have difficulties in conceptualising their information work, stated that they were unlikely to benefit of a graphic approach of sketching or drawing about the process. A possible explanation is that the information work related issues were explicitly problematic also to the informants. Therefore it might be assumed that the methods for revealing implicit structures [520] were bound to be ineffective in the present context, because some of the the structures were not well established even in an implicit manner. It is evident, however, that this particular issue needs further investigation.

Chapter 5

Archaeological work

The aim of the empirical study was to gather data about information work in the context of the archaeological work. The objective of gathering this data was to form an analytical understanding for studying the convergence of work and virtual reality based knowledge organisation from the information management point of view. The standpoint emphasises information and its functional pertinence in the work of individual human-beings, groups and systems (ref. Section 2). A special emphasis was placed on investigating the information interactions of the informants from the viewpoint of perceiving the interviewees as user actors. The starting point was the actual activities of the individual informants. The activities were reflected throughout the interview, compared with the general expectations (based on the interviews and earlier literature) and assessed for their representativeness.

The purpose of the current chapter is to present an outline of a participant perspective to the contexts, purposes, meanings and values related to these activities and the discipline and profession of archaeology. The topics cover a discussion on the nature of archaeology and archaeological work, how the informants perceive archaeology, the past from an archaeological perspective and the profession of archaeologists. The chapter is based primarily on the information gathered during the discussions on the themes 2 and 5 (ref. Section 4.5).

5.1 What is archaeology?

Literally the term archaeology stands for the 'study of ancient things' [210] or "the systematic description or study of antiquities" [693]. The concept reflects well the earlier idea of archaeology as a study, classification and description of artefacts, which was prevalent until the emergence of the explicit archaeological interest to study past societies from the late 17th century onwards [636, 8-9]. From our contemporary perspective the literal meaning has not become directly fallacious, but as the conception of archaeology has broadened beyond the earlier artefact-centrism, the description is quite adequate no more. Ancient materials and locations: finds[1],

[1] An object recovered during an investigation [210, small find].

artefacts[2], sites[3], structures[4] and features[5] are still in the very focus of archaeology. The object of study has, however, developed beyond the individual 'things' to embrace the gamut of past human pursuits [777, 36]. Roskams describes the change of the focus of the archaeological research as subsequent transitions from collecting, to collecting and classification, and later to collecting, classification and interpretation of data [636, 7]. At the moment, the constituent focus of the archaeology is in reconstructing the past without making distinctions based on an epoch or a culture [504, 3-7].

Shanks defines the purpose of archaeology as to discern objective knowledge based on empirical observations, to gather data and to formulate and test hypotheses [678, 18]. The interviews conducted within the frame of the current study indicated an according emphasis on the instrumental value of the materials and a general orientation to study the human past instead of the individual materials or artefacts [A-Z]. The general notion does not imply that an individual remain could not be interesting *per se* for an archaeologist, but rather a different focus of the general setting of the objectives. Earlier archaeology placed the emphasis on the materials as such (i.e. as physical objects), while the present archaeological theory accentuates the epistemological goals of archaeology within the frame of the humanities (i.e. as materials informing of the past).

In the contemporary discourse, archaeology is typically described as a scientific discipline, which is focussed on researching material remains in order to study past human life and activities [210][475]. Besides being a science, the practise of archaeology incorporates several crafts-like qualities as Díaz-Kommonen observes [231, 193-198]. Archaeological fieldwork and several other procedures of archaeological profession enjoins numerous practical skills from shovelling to the mastery of various analysis methods. As a practical and professional craft, archaeology drives an active process of coherence with the past and the present societies and carries direct implications to them both. At the present, the archaeological work is not only about research, but to a large extent it is also a practical undertaking of managing the past in the present. In this respect Criado [198] summarises the principal aspects of archaeology by conceptualising it as:

1. *Technology of criticism* for deconstructing the relationship between the present society and the past, and for showing how this construction legitimises the present.

2. *Technology of memoirs* serving especially the understanding of temporally distant processes of the prehistorical period.

3. *Technology of cultural heritage management*, which empowers the present society to accommodate the remains of the past to the landscape of the present.

[2] "[A]ny object which has been modified, fashioned, or manufactured according to a set of humanly imposed attributes, including tools, weapons, ornaments, utensils, houses, buildings, etc." [210, artefact], ref also [233, 174].

[3] "Any place where objects, features, or ecofacts manufactured or modified by human beings are found" [210, site].

[4] Here in the sense of a physical structure e.g. wall (ref. [210, structure]).

[5] As used in [210, primary fill], an identifiable entity of archaeological interest found e.g. in an excavation or in a landscape.

5.2 Archaeology as a science and scholarship

A distinctive characteristic of archaeology as it is today, is its increasingly multidisciplinary and multiperspective nature. Many of the methods, which are used in archaeology, have their origins in other scholarly disciplines such as history, linguistics, anthropology, natural sciences and social sciences [758]. Even though the scholarly standpoint of archaeology is typically the one of a humanity or of a social science, from the methodological point of view, archaeology is also a science [616, 12]. Besides the internal multidisciplinarity, the archaeological understanding of the past is complemented by different kinds of findings from extra-archaeological research contexts such as the historical and geological studies. This multi and cross disciplinary tendency has been reflected in the discussions on the nature of archaeology for some time [300, 5].

The crossdisciplinarity of archaeology emerges in different archaeological activities and viewpoints. The objectives of the archaeological investigations affect the choice of the research methods and vice versa. The two principal methods of the archaeological fieldwork, surveys and excavations differ considerably from each other. The surveys focus on unobtrusive inspecting, evaluating, identifying and locating both known and unknown sites and features of archaeological interest. An excavation is an obtrusive and intensive study of a single site.

The findings do also affect the progress of the study both during the season and afterwards. The materials may be analysed by employing a large variety of methods. The investigation may encompass a detailed scientific analysis of the raw materials and their composition, and a complex perusal of the cultural and societal values of the objects. The diffusion of the interests and the changes in the number and breed of questions posed on the archaeological materials has effectively contributed to the objectives and scale of archaeological fieldwork [636, 9], but also increased the crossdisciplinary interest and the emergence of multi-disciplinarity within the archaeology itself.

The position of archaeology among its related fields varies in the different parts of the world. In the Nordic countries, like in the most parts of Europe, the discipline has been tended to be seen as a humanity [210][616, 13][777, 426][9], whereas in the New World, archaeology is conceived to be a social science [777, 36, 426]. As a social science, archaeology has been seen in the US as being a 'past tense of cultural anthropology' [210][616, 11]. A quick survey of the institutional web sites complemented with the comments of the informants show that the impact of anthropology is visible also in Finland and Sweden, although its direct influence is less explicit and varies between the individual university departments. The influence and personal concerns of the department chairs is significant, albeit obvious determinant of the orientation. In Finland, the department of archaeology at the University of Oulu is most explicitly anthropology oriented [34], whereas the two other archaeology departments in the country, and most of the institutions in the Swedish universities subscribe to a more humanities oriented tradition. Within this framework, archaeology is perceived as a 'tense' of multidisciplinary cultural research and as belonging to the same group of academic disciplines with ethnography and history [32][40][399][364].

Apart from being anthropological, all archaeology is in a sense historical due to its aim of attempting to understand the humankind in a temporal scale. Archaeology department at the University of Helsinki confines the special focus of archaeology to the periods of human activity from which no literary evidence is

known. In contrast, the archaeology department of the University of Turku underlines explicitly the relevance of researching remains from the historical periods by using archaeological methods ([32] cf. [40]). Besides the broader epistemological considerations, the individual departments have focussed on a diversity of specialist areas of interest. Such emphases include, for instance, historical archaeology in Turku [40], environmental archaeology in Umeå [402] and scientific archaeology in Stockholm [364]. As the interviews pointed out, these general delineations do not, of course, necessarily represent the opinions and interests of all of the affiliated faculty and students.

Besides the scholarly, strictly research oriented crossdisciplinarities, archaeology has taken steps towards different practical disciplines. Although the cooperation is still rather infrequent [231, 102], the importance of the practical consultancies has been acknowledged and it seems to be increasing [M]. Archaeologists benefit of consulting different craftspersons, such as potters or shoemakers, in order to get information about the possible techniques and requirements of creating various kinds of artefacts and structures. The specific research direction known as experimental archaeology [616, 49] [L,M] studies archaeological features, structures and materials, and their production and use by recreating them with the help of authentic technology. Even though the consulting of the craftspersons, such as ceramists, is still broadly speaking rather rare.

In spite of the present emphasis on the crossdisciplinary connections, archaeology is clearly an independent field of study (ref. [210]). A survey of the current archaeological literature points out, however, the apparent complexity of explaining that what archaeology is as a scholarly discipline. In practise the interviews, the literature and the recent national and Nordic level statements on the common objectives of archaeology indicate of a rather broad basic consensus in both Finland and Sweden [A-Z] [758][415]. The cultural similarities between the Nordic countries as well as the relatively small number of archaeologists and university institutions, which educate archaeologists, help to explain the homogeneity comparatively well. Another apparent explanatory factor is the existence of large centralised national heritage administration organisations (respectively The National Board of Antiquities in Finland and the National Heritage Board in Sweden) in both countries. The two institutions are either directly or indirectly controlling and executing the majority of the on-going archaeological fieldwork. Their influence is pre-eminent, when it comes to the national archaeological discourse and field practises, but also to the education and the public image of archaeology.

Although archaeology is not discussed explicitly in the Whitley's comprehensive work on the intellectual and social organisation of sciences [821], the standpoint of discussing archaeology as a distinct community of researchers is useful for understanding the fundamentals of the archaeological multi, cross- and transdisciplinarity. In Whitleyan terms of strategic and technical task uncertainty, the archaeology resembles the post-1960 US sociology and ecology [821, 124 Table 4.1]. The uncertainty covers both the question about the eventual goals of the research effort and the one about how to reach them. From the dependency point of view archaeology is characterised by featuring a relatively low degree of functional dependence, but a relatively high degree of strategic dependence [821, 91 Table 3.1]. Archaeologists tend to be less dependent on the entire community of archaeologists in everyday life professional matters (i.e. functional matters) than in attaining their longer term professional and scholarly goals (i.e. strategic matters). The degree of functional dependency increases in national heritage institutions, but remains still

relatively low [821, 158 Table 5.2].

Archaeology shares a basic consensus of its far reaching goal settings, thus forming a community (archaeology as a community is discussed briefly also by Díaz-Kommonen [231, 218-219]). The means to reach these goals are, however, diverse. Coordination functions within the groups through the internal closeness of the personal contacts within the archaeological research communities. Cooperation is practised likewise between the different schools, research topics, theoretical frameworks and practical methodological directions, but its organisation is often incidental due the inherent problems relating to the augmented scale [777, 462-468]. The boundaries between the topics are not necessarily insurmountable, but the dimensional breadth of the possible approaches emphasises the diversities. The contextual distance between two research projects, such as between an effort relating to the Early American archaeology and another, which focusses on the Classical archaeology of Greece and Rome, can make a substantial difference even if the topic, such as 'navigation', would be the same. Similar gaps emerge due to the adoption of highly different research methods (e.g. discursive vs. natural science approaches) [U,Z].

From the reputational control point of view, archaeology is an 'academic science' in universities and a 'state science' in the national heritage institutions notwithstanding the considerable interplay between the bodies in both Finland and Sweden [821, 53 Table 2.1]. Whitley uses these two concepts to distinguish the (in principle) autonomous university based science and the state driven and controlled science pursued in the national laboratories and research centres [821, 53]. The degree, of how much the employees are oriented to the public science goals (versus the state controlled science goals [821, 8]) may be argued to be significantly high in both cases, even if the understanding of the idea of 'public science' varied between the state institutions and the universities. Academics might be argued to place more emphasis on the extent of the value, which is added to the archaeological material through a theoretically ambitious research and interpretation, while the national heritage boards may be purported to be emphasising the availability and communication of the physical sites and objects.

In summary, archaeology may be seen as residing on a tract between fragmentary and professional *adhocacies* following the conceptualisation presented in Whitley's *The intellectual and social organisation of sciences* [821, 168-176, 187-193]. By employment or affiliation, an individual is a part of a professional organisation: either a university, museum, heritage board or a private enterprise. In an intellectual and scholarly sense, every archaeologist is also a member in the far larger fragmentary community of all archaeologists, and eventually in other communities, which engage archaeologists, who have shared scholarly interests. High degrees of technical and strategic uncertainties restrict the functioning of a total collective control in archaeology, and leave more room for a personal and organisational supervision. Archaeology involves a plurality of practitioners and audiences, but the standard of common archaeological objectives is defined as common principles, which do reside high above the level of the intellectual practise of the individual stakeholders. Therefore the practical work allows relatively broad intellectual individualism as far as the individuals follow the basic principles of the community.

5.3 What is archaeological work?

Archaeological work is a characteristically diffuse enterprise. The simple question of who is an archaeologist and especially who is working as an archaeologist becomes blurred by the diversity of the duties ministered by the archaeologists in different organisations [A-Z] (ref. [148]). Therefore it is apparent that the scientific and professional discipline of archaeology is held together rather by a common scholarly notion of the meaning and value of archaeological work, than by any distinct work profiles.

The professional archaeological work differs rather significantly from the academic subject of archaeology. From a profession point of view, archaeology is a craft and a vocation, whereas from the academic point of view, it is a scholarly pursuit (ref. [148]). This polarisation makes archaeology distinct from many traditional professions, where the focus is on providing services or commodities instead of seeking meaning [148]. The distinction between the scholarly and professional spheres is reflected especially in the patterns of practical work, project management and prioritising. The professional rescue archaeology and cultural heritage management work is emphatically concerned with the technical aspects of conducting investigations, preservation and management, and to a degree, of the dissemination and communication. In an intellectual sense, the difference between the academics and professionals is less clear. The expressed scholarly objectives of the professional activity tend to resemble the objectives phrased by the academics [H, O, P, V]. In practise, however, it seems that the scholarly premises of the archaeological work are reflected rather vaguely in the professional archaeology and vice versa. The professional work is driven by a professional paradigm, which emphasises an effective and efficient collection of data, while the scholarly pursuits have been concerned notably little with the practicalities of the 'everyday archaeology'. The origins of archaeology as an intellectual interest and discipline rather than as a profession, and the continuing coexistence of a scholarly intellectual basis and a thrive for the professionalisation of the work, contrive an evident gap between the academic and professional archaeologies.

The status of the professional archaeology in the two Nordic countries is rather unlike even though the practical working conditions of the archaeologists resemble closely each other (ref. Section 5.4). Simultaneously, the scholarly and scientific views express more consistency. Archaeologist Näsman underlines in an interview [260] that archaeology has played a focal role in the project of constructing national identity in Sweden, Norway and Denmark, while in Finland it has had a clearly lower national status. The Finnish informants, who were interviewed in the current project, were relatively content with the intellectual and cultural appraisal of archaeology in Finland [260]. The appraisal was considered to be, however, rather poorly reflected in the national and local funding of the archaeological work.

Compared with the scholarly work in the humanities in general, the archaeological academic research is typically a somewhat more collective enterprise. Even though the stereotypical idea of a humanities scholar who is working alone, is not the whole truth [9, 110][736, 294], it bears some technical meaning, because the research interests tend to be rather personal, than distinctly collective [384]. It may be true that the humanities subjects raise relative seldom such economic interests, which would bring scholars together [9, 110] in a comparative manner to the sciences. The outdated impression that the humanities scholars tend to work alone, even if they did to a extent, is especially misplaced in the context of archaeology,

where the work is often highly collaborative (ref. [118, 11]). Especially the fieldwork and the scientific analyses are typically carried out as a collaborative enterprise, due to the related costs and the amount of work. The subsequent scholarly research, on the other hand, seems to be still largely a solitary effort. The individual studies of the specific types of artefacts, ecofacts, buildings or of the local environment do provide insights into the common subject from different angles. The practical progression of the cooperation is, however, largely dependent on the continuance of financing, and on the subsequent possibilities to continue the scholarly work on a full-time basis [D, E, V].

5.4 Motivations and satisfaction

The following two sections discuss the archaeology and work related motivation and satisfaction of the informants. The discussion focusses on explicating purposes, meanings and values of the archaeological work from the informants' point of view. The understanding serves to highlight the rationale of the archaeological work, which will be scrutinised further in the work role analysis, in Chapter 6. The role of motivations is central also in the process of negotiating the boundaries between the individuals' personal information behaviour and preferences, and the choices, which relate to the assumed work roles (ref. Section 7.3).

5.4.1 Positive aspects of archaeological work

Informants were asked to tell about the positive aspects of the archaeological work according to their own experiences (ref. Appendix B). The primary purpose of the discussion was to identify common motivations, which engage archaeologists to the their work, make people to begin to study archaeology and to recruit into the sector. Many informants mentioned a general interest in history and archaeology as their principal motivation for entering an archaeological career. The orientation towards fundamentally human-related issues was seen as an equally interesting aspect of archaeology. A somewhat more abstract idea of the 'joy of discovery' was also mentioned frequently as a significant motivation for conducting archaeological work. Most of the interviewees were clearly satisfied with their primary work in archaeological research, fieldwork, administration, museums, development and support, and in education. The general satisfaction is also communal, not only individual. One of the interviewees remarked that there is a discernible collective self-esteem and sense of importance in archaeology and being an archaeologist.

Irrespectively of the work duties, many of the informants deemed the fieldwork as the most interesting aspect of archaeology. One informant noted that large excavations are always more interesting, because there is usually a chance to find more, and hopefully better preserved remains than in smaller scale projects [O]. Larger excavations also give wider and better perspective to the site and therefore uncovers more information about the past. Another interviewee remarked though that her primary motivation came rather from thinking up new interesting things than in finding something tangible [G]. This rather anomalous viewpoint is best explained in this case by the emphatically academic orientation of the informant.

Besides substance related motivations, the public dissemination was indicated frequently as the most interesting and the most challenging duty of the archaeologists. Generally speaking, the current state of affairs was, however, described to

be somewhat unsatisfactory. Archaeology could be more visible and archaeologists might be more active in communicating with the general public. The satisfaction of interacting with people covers also the possibility to meet colleagues and get acquainted with new research topics. An informant, who works in collections management department, emphasised this as an essential source of satisfaction and motivation in her work [I]. The cooperation serves a social purpose and makes it possible to keep oneself informed about the current trends and the state of the art research.

The comprehensiveness and the diversity of duties were generally seen to be a challenging and positive trait in the archaeological work. Only one informant mentioned an explicit fascination in artefacts [I], which was earlier, unlike today, one of the principal motivations of archaeological and antiquarian studies [777, 57-59]. Most of the informants emphasised the instrumentality of the artefacts and the primacy of human issues.

Some informants expressed also a more specific interest in a precise period or theme. References to the wider societal debates or to an ability to contribute beyond the scope of cultural self-efficacy were rare. One informant observed that the understanding of past societal and cultural processes gives archaeologists perspective and possibilities to contribute to the contemporary social and societal debate. Most of the interviewees did, however, consider the old idea that history and archaeology might be capable of 'teaching' something, to be rather distant.

In summary, the responses indicate that the archaeology itself is perceived as highly motivating (also in [444]). The motivations and interests of the informants accentuate also the idea of archaeology as a human discipline. The interviewees valued and esteemed especially the possibility to understand past human beings, and to communicate this understanding to the contemporary public.

5.4.2 Issues in archaeological work

Besides the positive aspects, the informants were asked to reflect the most pressing problems in archaeological work in the light of their present professional duties and earlier experiences. The most pressing problems mentioned by the interviewees concerned mostly the employment difficulties in the archaeology sector. The observations applies the both countries, even though the concerns were somewhat more accentuated in Finland.

The lack of permanent positions is a major deficiency of the profession, because it ushers a number of archaeology graduates to seek positions outside the field. None of the administrators complained, however, about any significant problems of hiring proficient excavators on a contract basis. The shortness of the contracts was, however, indicated to cause complications on the possibilities to organise the work efficiently and to, for instance, analyse the findings comprehensively during the post-excavation phase [C, D, P]. From the institutional point of view, the employment situation was seen as a real threat, because of the immanent knowledge leaks (i.e. organisational knowledge that disappears or never comes into being). Also the possibilities to use the expertise of the individuals in diverse tasks, which would benefit the entire organisation, are lacking, because the personnel is employed in individual projects on external funding. From the employee point of view, the same issue is reflected in the temporary nature of the employment. Archaeologists may work for years in short projects following one another and occasionally intervened by periods of unemployment [C, W] (also in [14][444][817]).

Besides the labour market issues, the informants from the both countries highlighted also the effects of the organisational problems within the governmental administrative bodies. A complex and impractical organisation and illogical distribution of duties and tasks make the practical work exceedingly difficult in a number of instances. A lot of potential is wasted, as one of the informants formulated the problem [C]. Another informant complained about the high proportion of time used for a useless administrative bureaucracy [A] (also in [449]). A Finnish archaeologist, who works in a university, remarked that the administrative work as such is not the worst problem, but the fact that the time used for administration reduces in direct proportion the time, which should be available for the actual work, that is research and teaching ([M] also in [449]). Haste, increasing workload and the diminishing number of staff was indicated to cause complications also in the museums and administrative bodies (e.g. [L, O, P, W]).

The uncertain future prospects of hiring and getting proficient personnel to manage the cultural heritage assets in national museums and antiquities administration was also expressed to be an actual problem of the archaeological heritage work [C, I, P, W] (ref. also [817]). The question of the role and meaning of the archaeological collections has been widely debated in Sweden during the last few years with a reference to the director appointments at The Museum of National Antiquities in Stockholm [434]. The central question is, whether the emphasis should be placed on the preservation or the communication of the collections, and how to retain a working balance between the two functions of the institutions. From the employment, but also from the workload point of view, a typical related problem was the overall shortage of positions: "On my opinion there would be work to do for more archaeologists in this field" [a Finn]. With a small staff the prioritising leads quickly to the closedown of less relevant functions.

The resource problems were stated to cause complications also to the scheduling of the work. One informant had observed tightening constraints in the rescue archaeology contracts approved by the local provincial administration. According to her, the shorter time and lower resources are likely to cause an increase in the number of cases, where the investigation has to be finished before its completion [D] (also in [444]). The practical need to prioritise was widely acknowledged, but beginning an investigation and leaving it before its completion was seen as a real threat to the archaeological heritage [P]. Excavating archaeologists and administrators were generally more sensitive to the practical requirements to accommodate the level of detail even if the basic rule of excavating and documenting everything in a relevant accuracy prevailed in the arguments. An overall anxiety of seeing something destroyed, which has not been properly investigated, was repeated by many interviewees.

The resource problems prevailed in the answers both in Finland and in Sweden. One Finnish informant emphasised the need to increase the national funding to the level of the other Nordic countries to get some relief to the immanent resource problems [C]. In spite of the general view in Finland that archaeology is significantly better funded in Sweden, the standard worry of their Swedish colleagues was that the funding is severely lacking even there and the number of the archaeologists is not sufficient to carry out all the necessary duties. The lack of resources is reflected also in the inadequate facilities and instruments [P, O, W] (ref. also [444]). The resource problems evoked also straight answers about the "awfully" low salaries [P]. In regional and municipal level, the salaries were indicated to be varying considerably between the individual organisations. Besides the variation, they were also

indicated to be significantly lower than in the state-run organisations (e.g. [P]).

One of the informants saw shortcomings also in the appreciation of archaeology in the labour market, in a low valuation of archaeology as a scholarly discipline, and (in Finland) in the comparable lack of institutionalisation in comparison to some related disciplines such as history and linguistics [M]. One reason for the described state of affairs was suggested to be the young age of the scholarly archaeology in the country. Archaeology is not institutionalised as well as its neighbouring disciplines, which considered to be causing shortages in funding, and eventually, inner conflicts and uncertainty within the discipline. The observations were complemented by another informant, who was concerned with the limited visibility of archaeology in the society. Archaeology is seen, according to the informant, mostly as a fieldwork, without any of the farther reaching dimensions of the discipline. The informant underlined, however, that a central reason for the image problems were the archaeologists themselves, who are reluctant to take any steps to the direction of redressing them [E].

Difficulties in public relations were mentioned by many administrators. In land archaeology, the situation seems to have developed to a better direction. Nowadays, the exploiters come rather well in terms with the archaeologists. The relationship was described to be co-operative, constructive and professional. The landowners, who consider the archaeological materials as their private property, are becoming fewer. Simultaneously the earlier prevailing attitudes towards the archaeologists as the people "who will rampage private property and prohibit its further use" are fortunately waning [P]. In spite of the positive trend, some recent contrary experiences were reported [D], but generally development was perceived as promising. In the maritime archaeology, the situation is rather more inflamed in the both countries. In general, the cooperation between the maritime museums and amateur divers is functioning well. In spite of the large number of considerate divers, the plundering is, however, still a real threat to the maritime heritage. Partly the problems may be explained by the problems related to the inconsistent legislation, but one of the interviewees expressed concerns of a growing public neglect of the underwater heritage [A, C, E, J, P, W] (ref. [143]).

Besides the prevailing resource and public relations issues, the individual interviewees mentioned also other problems such as the time-consuming organisational changes, hardness of the physical work (also in [444]) and the shortness of the field season in the Nordic countries [C, D, F, M, O, P]. Due to the weather conditions, fieldwork is possible in Finland typically from April or May to October-November. In the middle and southern parts of Sweden, excavations may be kept running almost year-round. The seasonal nature of the work causes stress and unemployment in wintertime [C, D, O] (also in [449, 603]), although as indicated in a report written by Kindenberg [444], the lengthening of the field season may be another source of stress, if the time for the post-excavation processing of the finds and documentation becomes reduced [O]. The diversity of the work, which relates to the rotation of different kinds of physical and intellectual work, was generally seen as a positive trait, even though one of the informants considered it to be a source of complication [D]. The provision of, for instance, befitting tools and education, turns out to be problematic due to the diversity of the working conditions.

The reflections of the informants indicate clearly that the problems, which relate to the archaeology, are concerned mostly on resourcing, and the public image of the profession and the scholarly discipline. The statements were significantly similar between the two countries and it seemed that the practical problems were

similar in spite of the many approach orientated and policy level differences. Permanent positions and possibility to work properly were prevalent wishes in both countries, even though most of the informants were hesitant to mention them in the first place. A very probable reason to this tendency might be expected to be that the question was located in the first part of the interview. It is plausible to expect that the informants were somewhat uncertain about whether the interviewer considered the lack of resources to be an 'archaeological' issue. Another explaining factor may be also expected to be an impending hesitance to present direct critique on the superiors and policy makers.

5.5 Meaning and value in archaeological work: the perspective of an archaeologist

The earlier discussion on the nature of the work concluded that it is a distinct set of inter-linked human activities with explicitly or implicitly understood purposes, meanings and values (ref. Section 2.5.1). The present section discusses these purposes, meanings and values, which constitute archaeological work from the viewpoint of the interviewees. The informants were asked to reflect their perception of the nature of archaeology and the motivations, meanings and values, which affect the archaeological work. The discussion focussed on explicating personal experiences and considerations, which formed a basis for establishing an understanding of the shared conceptions.

As an essentially intangible asset, the archaeological knowledge (or any other knowledge about the past) is difficult to measure in terms of purpose and value. The presented reasons for why someone should know something about the past related in the discussions to the notions of identity, self-consciousness and contextualisation of the present [D, M, N, O, P, R, T, U, V, X]. The simplistic idea of history 'repeating itself' or being a 'teacher of the present', was approved by no-one (e.g. [E, N], [777, 443]). A comparable, but significantly different notion that an understanding of the past is a general necessity for making statements about the present and on the future, was explicitly shared between the most of the informants, as well as the general idea of history as a necessary basis for a cultural and societal existence of the human communities [e.g. E, M, J, T]. Several informants pointed out the value of conceiving that the roots of the present day practises and crises are in the past [e.g. C, E, I, J], and on the other hand that crises and disasters have always existed [I]. The contemporary world phenomena become easier to understand, when they are proportioned to the length of the human history and the transience of the present [E, L, P, S, T].

Besides the notions of self-consciousness and identity, the archaeological work and understanding of the past were perceived to bear directly important emotional values. The understanding contributes to the positive feelings and experiences [N], richer life-world [J] and the enjoyment of knowing and finding out new things [A, J, O]. The repeatedly stated intrinsic value of archaeology [A, G, J, Q, W] relates both to the sphere of emotions and to the societal need to construct and maintain a sense of common origins among the members of the community [N]. The intrinsic value relates similarly to the addressing of the fundamental questions of the human existence: the need to cope with the questions like "where I do come from" [F, J, S], "why we are here" and "why we are like we are" [F]. The intrinsic nature of the knowledge about the past was further underlined by one of the informants:

"if no scholarly knowledge of the past would exist, some other kind of knowledge would undoubtedly replace it" [H]. People might live without knowing about some archaeological sites, but as one of the informants remarked, so might they also live without owning a mobile phone [A], and yet their necessity is rarely questioned.

The informants conceived the meaning of archaeological work primarily in societal and individual terms, which relate to the notions of identity and cultural cohesion. In the respect of its meanings, values and purposes, archaeology is a 'culture', not a 'science' if this problematic, but common distinction should be maintained (ref. [337]). Archaeology is meaningful through the prevalence of the sensed necessity to understand the temporal dimensions of the human activities. The intrinsic value of archaeology is difficult to measure, because the interest in the past is a part of being a human.

5.6 Who owns the past?

An archaeologist, who is involved in archaeological work is not the only stakeholder in the archaeological information process and in the pursuit of studying past human activity. Archaeology is discursive as a scholarly and practical discipline, and as already observed, the purposes, meanings and values of archaeological activity are dependent on the audience. The purposes, meanings and values essentially become defined in the cognitive, cultural and societal contexts of the audiences of archaeology. To explore the motivations of archaeological work, and the individual practises of work and the information work, the informants were requested to elaborate on the question of who own the past, for whom the archaeology does exist, and for whom the archaeological work is being done.

The general tendency of the discussions was that the past belongs to everyone of us [I, O, P], and on the other hand that no-one may actually own the past [N] even if it seems nowadays that in effect, the juridical owner would be the nation state [V]. The notion of responsibility was also seen as a fundamentally collective question. As the past is considered to be in a public domain, the archaeologists do have a responsibility to nurture the heritage of the past and to tell the public how the things were in the past according to the best available knowledge [R, U, T]. Archaeologists are perceived to have a special role as experts who have no right to own the past, but who have a responsibility to function as guides or counsellors. In this respect the archaeologists themselves tend to make a clear statement in the archaeological discourse of not claiming the ownership (cf. [K, Q]), but still acting as an important group of stakeholders. Conversation and communication within this forum of specialists was considered to be important for the scholarly pursuits, but being only a part of the project of communicating the archaeology and archaeological understanding of the past. Two of the informants regretted the continuing tendency among the archaeologists to write primarily for their own scholarly community instead of regularly communicating the research results also to the general public [H, M]. Despite the persistence of an 'ivory tower mentality', archaeology was seen as more open than it had been before. Some of the interviewees criticised directly the researchers of the older generations of keeping research materials for themselves, and maintaining a sense of personal ownership of the materials they had excavated [M, N].

Most of the informants saw themselves primarily as producers of archaeological information and knowledge. They perceived that the intrinsic value of the archaeological information was linked to the notion that an archaeologist is intel-

lectually responsible for the work only for herself, or at the most, to the scholarly community [F]. A variation of the same perceptual viewpoint is to see an audience as 'everyone of us', and to underline the requirement of personal sincerity and public responsibility. The most typical way of conceptualising the issue of audiences was to see oneself as a participant in two discourses on the same subject: the public and the scholarly. The community of researchers represents only one audience to an archaeologist. Besides the scholarly debate, there should be a simultaneous interaction going on with the general public [A, B, C, E]. The point of discussing archaeology with two distinct audiences is not to see the audiences as groups on two different levels of importance, but in making a distinction to the manners and means of communication.

The cultural heritage administration, and especially the educational work involve a stronger sensibility for the necessity to explain and justify the archaeological work to the general public. One of the informants declared explicitly that she feels especially satisfied when she gets a previously non-interested person to get interested in archaeology [L]. The standpoint is an important step away from the common bias of seeing the 'general public' as a community of people who are already interested in archaeology. In practise, the visible audience consists of the interested enthusiasts, but the role of archaeologists as the managers of the cultural heritage and human environment, and as important stakeholders in the landuse projects, widens the sphere of involvement of the archaeologists. From the cultural heritage management point of view, (in principle) everyone should be deemed as being concerned of the archaeological work [W].

The archaeological work carries its values and meanings on a diversity of levels and contexts. The legitimising meaning of the archaeological work is to cater for the public and societal interest on the shared past of the humanity by discovering, studying, communicating and preserving its material manifestations. The value of archaeology contributes on the collective and individual identity. It is difficult to measure due to the intangibility of the heritage asset and due to the volatility of the work itself (ref. Section 2.5.1). The opinions expressed by the informants follow the general lines of the literature [696][147], even though the statements suggested rather pragmatic views on the question who actually owns the past and the 'archaeological' objects. On the level of the explicit opinions, the informants "understand themselves to be a part of a cultural service to the public" (cf. Weniger in [308, 65]). On the level of the practical work, however, the notion of ownership and necessity of the individual duties becomes more blurred. The work processes incorporate purposes, meanings and values, which might be claimed to be 'archéologie pour archéologie' (ref. Section 7.5.2). The explicit disputes between the general public and the archaeology professionals were strikingly visible only in the maritime archaeology. In contrast, the situation in the land archaeology in the two countries, appears to be moving towards a rather fruitful consensus of archaeological, public and land owners' interests.

In conclusion, like all work, also the archaeological work, its motivations, meanings and values seem to be in a permanent state of making. The change requires constant attention and forces archaeology to explore itself over and over again. Therefore the present meanings, purposes and values are bound to change.

5.7 Summary

This chapter discusses the diverse meanings and values, which are related to the archaeology and archaeological work. The present understanding of the archaeology perceives it as a discipline, which focusses on studying past human activity based on its material remains. Archaeology is a multidisciplinary subject, which combines a broad range of analytical methods from the natural sciences to the humanities. The meaning and value of archaeology is seen to be largely intrinsic and to reside in its capability to provide perspective to the contemporary culture and to support the self-comprehension of individual human-beings. The informants themselves do generally consider themselves to be motivated by their work. The most critical issues seem to be relating to the outdated public view of archaeology and the limited resourcing of the practical work.

Chapter 6

Archaeological work roles

Because in the present study, the analysis has already tackled with the motivations, meanings, values and purposes attached to the archaeological work, the next step is to see closer to its structure and organisation. This chapter explicates altogether seven 'work roles', which provide a structural and systemic framework for discussing the archaeological work. The structured approach complements the broad understanding of the contexts, purposes, meanings and values related to the archaeological work and information work. The findings discussed in this chapter are based on the information, which was acquired during the interviews on themes 2-4 (ref. Section 4.5). Focus of the discussion was to scrutinise the following issues:

- What kind of information work exists in the frame of archaeology?
- What information means in the context of the informants? As no familiarity of the theoretical debate on the nature of the concept 'information' (Section 2.4) might be expected from the part of the informants, the first objective of the interview was to get an adequate picture of the work roles related information horizons without interference of diverging concepts of information.
- Where does the information, which is used by the archaeologists, come from? Basically it was assumed that the information horizon of the informants consisted of diverse explicit, but also implicit sources. In addition to the active and self-understood information use, the discussion on the work practises and the typical workflows was directed to reveal the explicit *loci* and sources of information.
- Where and how the archaeologists seek actively new information and what kinds of explicit information needs they have? The complementary questions and the survey of information sources was used to scrutinise the active information seeking behaviour of the informants.
- What kind of source, usage and production preferences do the informants have? The aim was to establish where the archaeologists would prefer to look for information while working, what kinds of sources they favour, what reasons they have to look at the distinct kinds of sources and what kinds of information products they prefer to produce themselves.

The present chapter outlines the ecology of archaeological work using the notion of *work roles* as a conceptual framework for the *information work analysis*. A work

role is perceived to be an analytical unit of the information work. The roles do not directly reflect any actual organisation of the practical work, but they are used to articulate the constituent information work related units discerned from the material during the interviews. The set of the identified work roles reflects consciously an information management point of view on the archaeological work. The approach is not suggesting to be a 'correct' representation of the archaeological work from any other viewpoint. The analysis identifies within the scope of each role a set of relevant *root definitions* and *use cases* (ref. Section 6.1). The root definitions are scrutinised further by classifying the related constituent *information interactions*. The investigation is concluded by discussing analytically constructed work role specific information horizon maps.

The principal motivation for choosing a work oriented approach to study the information use is its proximity with the practical conceptualisations of the informants. As Winograd noted already in 1988, "people are placing orders, requesting and producing reports and releasing products, *not processing information*" [844]. A field study is necessarily an enterprise of talking about the work people do, not the ways they interact with information. The concept of information is vague and it becomes more vague in the context of the human life-world. Therefore it is far easier and far more relevant to talk with people about their work than their information use.

The second important aspect, which braces the work oriented approach relates to the premises and implications of the information research. The purpose of studying information use, needs and behaviours is not in enabling information use *per se*, but in empowering people to do their work by amending their information interactions. An information use oriented study is in a risk to concentrate on the secondary information use issues rather than on the constituent factors relating to the accomplishment of the work. There is little sense in providing a clerk with a more comprehensive telephone catalogue with both mobile and pager numbers, if the essential problem would be better solved by contacting the customers by email. An information use oriented approach may well grasp the constituent issue, but in an attempt to do so, the analysis is necessarily a significantly longer process than an analysis, which is based on the study of the work. A work oriented approach empowers the researcher to concentrate on the focal points of the information use on a level of granularity, which corresponds with the purposes, meanings and values of the activities understood by the informants themselves (ref. Sections 2.5.2 and 2.5.1, also [613]). Work is a broad enough concept to grasp the essentials of the entire activity, but simultaneously confined enough, to allow an indepth perusal.

6.1 Methods of information work analysis

This study has cognisantly assumed an inclusive notion of archaeology (Section 5.1, cf. [148]). The basic criteria of the material selection has been to confine the investigation to the informants, who are working with archaeological material and archaeological issues (Section 4.2). The archaeological work is perceived as a soft system, which comprises resources, conventions, structures, infrastructures and actors who profile themselves in different work roles. The system, like its participants have an individual sense of the common and personal purposes, meanings and values. It is ecological in the sense that it is evolving and its is being situated and framed within, and by, its surroundings. This system is perused on two levels: on the level of work itself and by focussing on its information component referred to

as information work.

The interview data was analysed on the basis of digitised tape recordings and draft transcriptions. The Transana and Transcriber software packages (in Section 4.5) used in the process of transcription allowed a simultaneous processing of the audio track and the text. The entire transcription and coding work was conducted by the author, which eliminates the bias caused by an eventual lack of intercoder reliability. The simultaneous processing of transcription and audio data reduced the need to complete a comprehensive transcription of every utterance and yet made it possible to work with a complete set of data (referential adequacy [491, 313-314]). Furthermore, the approach allowed a continuous evaluation and revision of the transcriptions in order to increase their reliability. The initial data analysis was based on a combination of grounded theory [741][188] and schema based approaches [648, 782-784], which was elaborated in the later stages using writing as an explicit form of inquiry [623]. The first stage of the data analysis was conducted already during the interview phase by developing a tentative general theory of the structure of the archaeological information work. This theory was developed and elaborated in another iteration during the process of transcription. The theoretical coding of the data was based on the observations of a likely significance of the recurring patterns of the similarities and dissimilarities in:

1. Formal work duties (e.g. collection management, field work, teaching) and titles (e.g. antiquarian, project researcher, lecturer, researcher)

2. Environments and scenes of work (e.g. museum, archaeological site, university)

3. Objects interacted with (e.g. shovel, computer, collection of finds, literature, pottery)

4. Activity, how its done, its meanings, purposes and values (e.g. to unearth and document an archaeological site, to tell the public about the Bronze Age[1], to teach archaeology students)

The practical analytical work progressed by constructing a theory on the basis of discernible patterns in the discussion between the interviewer and the interviewee. The following short example illustrates the material and the method of analysis (the numbers refer to the four broad categories of patterns listed above):

> **Interviewer:** I would like you to describe your practical work from the beginning to the end? Is it possible to divide the work into some phases? What do you need to know in each phase, what kind of information do you seek and where?
>
> **Interviewee:** For practical reasons or its implicit reasons, archaeology is about this **(1, 2)** ***fieldwork*** and **(1)** ***research, which is based on*** **(3)** ***the literature***. And all the time we should think about the **(1)** ***teaching*** and I actually learn quite a lot while thinking this and that, and **(4)** I ***develop*** some idea of the future lines of my research and archaeology itself. It is not very precise, but still indicative of the forthcoming. [..]

[1]The archaeological themes and examples referred in the text have been altered in order to preserve the anonymity of the informants. The examples do, however, correspond directly with the actual research topics, case examples and stories told by the informants.

The third iteration consisted of a schema analysis [648, 783-784] of the transcriptions and audio tracks. It was conducted according to the coding, which resulted as a tentative set of narratives of the information work in altogether seven archaeological *work roles*. The work roles were based on a structure, which appeared to frame the organisation of the work in the discussions (cf. [148][2]). The work roles were further elaborated in successive iterations of writing and re-writing the descriptions, which evolved in to the final work role and work process descriptions (ref. e.g. Sections 6.2.1 and 6.2.2). Before the descriptions were finalised, a negative case analysis [491, 309-313] was conducted to evaluate the credibility of the work role assessments. The analysis did not produce, however, plausible alternatives to the assumed grouping. A adapted 'member' check (cf. [491, 314-316]) of the completed analysis results was conducted by introducing the results to archaeologists in two occasions. The approach of verifying the results with non-member archaeologists was chosen to measure the general resonance of the findings instead of their credibility within the scope of the group of informants.

Due to the conversational nature of the interviews, the analysis was conducted by iterative writing rather than by conducting explicit phases of coding and analysing the material. The interview guide provided tentative structure for the 'stories', which were told by the informants. The interview guide and the stories formed together a structural basis for the analysis. The interview guide provided a precoding, while the actual coding was based on the stories, i.e. on the data itself (ref. [272, 229]). In the present study the coding was not merely analysis (ref. Miles and Huberman [523, 56]), but also a part of the process of elaborating the results of the analysis.

Following the lines of the *role theory* [323][325][94] (Section 2.5.2), the roles are perceived as clusters of similar or nearly similar work duties, tiles, scenes of work, objects interacted with and activity (ref. coding above on the preceding page). A role is not a direct representation of a job description of any individual. It is rather a profile, which may instantiate as a work description by its own, or by combining several work roles together. Roles do change, but slower than the work profiles. For example, an archaeologist might be involved in field work, academic research and infrastructural (in a colloquial substrate-like sense) development [e.g. A]. Another archaeologist might be working primarily with cultural heritage administration issues, but her principal duties are combined with several antiquarian assignments, occasional field archaeology, public dissemination and academic teaching [C]. Due to the overlap, inevitable change and an individualistic articulation of the work roles in each of the professional profiles, it is infeasible to present their precise distribution among the individual informants. As a general remark, it seems, however, that all of the interviewees had a common ground in field archaeology and in research. Basically all informants were or had been involved in field archaeology during their career in addition to the obligatory training included in the curriculum. Everyone had also conducted at least a limited amount of scholarly research. The rest of the roles appeared to distribute rather evenly in the informants' profiles.

The seven work roles are:

1. Field archaeology
2. Antiquarian

[2]Note that Carter and Robertson [148] use a significantly different framework and method of analysis. In spite of the differences, the results of the current study generally concur with the units and elements of Archaeological Occupational Standards Framework [148, 20-25].

3. Public dissemination
4. Academic research
5. Academic teaching
6. Cultural heritage administration
7. Infrastructural development

In accordance with the purpose of the present study, the scrutiny was focussed on integral top-level processes, which pertain to the archaeology related work, instead of individual work tasks and their functioning. The processes are perused using a four level analysis, which consists of the following steps:

1. Actor-context analysis, which is based on the use of root definitions
2. Process task analysis with a use case approach
3. Information interactions assessment and classification
4. Description of the work role specific information horizons

The four step approach of the information work analysis allows a deep scrutiny of work and information work, because of its scope, which ranges from a domain level analysis to the explication of very specific activities and motivations. The approach makes also possible to analyse the primary actors, qualities and motivations of the work. The aspects of control and coordination articulate in the analysis of the obstacles and criteria of the interactions, individual use cases and tasks, and the essential contexts and situations, where the work occurs. The first two steps help to identify the organisation and the structures, which reside in the work. The following two steps are used to explicate the ways how an organisation comes into the being and how the system functions in the practical information interactions and behaviours of the participating actors.

1) The activities, which are associated with the **actor-contexts of the work role**, are described using *root definitions* [157, 166-168]. By definition a "root definition is a concise, tightly constructed description of a human activity system which states what the system is" [157, 317]. The root definitions are explicated according to the CATWOE-criteria [700] from the viewpoints of all the major actors in each of the work contexts. The mnemonic CATWOE stands for **C**lient, **A**ctor, **T**ransformation, **W**eltanschauung (world view), **O**wner and **E**nvironment. The necessary understanding, which supports the construction of the root definitions, is derived principally from the discussions on and around the interview theme 2. Because the focus of the current study is on the archaeological information in archaeological use, the viewpoint is centred on the information gathered from the archaeologists acting as informants, i.e. being experts of their own field of study.

The root definitions and the CATWOE criteria are derived from the Soft Systems Method (SSM) developed by Checkland in a series of publications from the mid seventies onwards. The methodology is summarised in his 1981 book *Systems Thinking, Systems Practise* [157]. The technique is used in its original context as a tool for analysing the problems and 'systems', which are involved in the information systems development, and expressing a hypothesis of a relevant 'system'. The root definitions are particularly useful in clarifying the studied situation by exposing the different views and opinions held by the different stakeholders (including

CATWOE		Example of the **Academic teaching** work role from the teacher point of view
Client	refers to the beneficiary or victim, who is affected by the described activities	Student of archaeology (who benefits of the teaching activity)
Actor	is the agent who is responsible for carrying out the operations	Me (the teacher who carries out the operation of 'teaching' the student)
Transformation	is the core of the root definition, which describes what is happening	Getting an archaeology student to become concerned and informed of the constituent aspects of the archaeological knowledge so that she will be able to work as a professional archaeologist.
Weltanschauung	(world view, 'all that you take for granted') are the assumptions and the mental 'landscape' where the root definition functions	It is important to ensure that the students learn the essential content of my teaching and obtain proficiency in the science and craft of archaeology.
Owner	is the sponsor or the controller of the activity	The community of archaeologists; University; Me
Environment	is the space or environment where the activity takes place	University

Table 6.1: The CATWOE mnemonic [700][157, 224-227]

e.g. the users, contractors, customers and the management). The root definitions are analytical compositions of the attitudes, opinions and worldviews, based on several individual responses. The definitions are written in a first-person, but they do not correspond with any actual responses word-to-word. The CATWOE is a method for expressing the root definition in a formalised manner (ref. Table 6.1).

Root definitions and the CATWOE-criteria are fundamentally a goal-oriented technique intended to actuate the change in an organisation. Here the technique is used as an analytic instrument for articulating the boundaries and the constituent operations embodied in the systems, which are determined by the identified archaeological work roles. A further purpose of the approach is to use the attained understanding in conjunction with the stated problems to enquire into the formation of the information work in each context. Considering the objectives of the present study, an important implication of the the root definitions approach is the possibility to articulate throughout the analytical process the organisational foundations of the encountered information management related problems.

The understanding of a work role acquired in the analysis of the principal actors and their motivation by using the root definitions, is elaborated by a closer **2) analysis of the information interactions** within the context of each role. The role related interactions are summarised in top-level *use case diagrams* drawn loosely according

to the notation of the UML[3] specification version 1.5 [559, 2-219] (ref. e.g. the use case diagram of academic teaching in the Fig. 6.11). A use case diagram allows describing the high level user goals in relation to a set of confined 'regions of work' (i.e. soft systems) and their surroundings. Basically the diagrams are comparable to the conceptual models of SSM [157, 169-177]. Unlike the conceptual models, however, they do offer an advantage of placing a further emphasis on the presence of the actors in the interactions. The emphasis is constituent in the present study, as the entire project of archaeological work is tightly interwoven with the interpretations and the actor-driven context of activity (Section 5.2).

The link between the root definitions and the use cases is, in essence, dispositional. A use case is considered to be a disposition defined by the system. Simultaneously it is acknowledged, however, that the use cases induce completely different dispositions on the problem solving practise than the ones expected within the system [161]. The use cases are based on the root definitions, but in an analytical sense, the root definitions are usable also in articulating the use cases to the opposite direction. In this study, the goals are not specific tasks or actions, but they do rather represent the general lines of action. The analysis of the information interactions focusses on the cases, which reside within the system of archaeological work drawn (solid rectangle, e.g. in Fig. 6.2) in each of the diagrams. The subsystems of the archaeological system are respectively drawn with dotted lines (e.g. in Fig. 6.13 on page 175). The related customer side use cases are illustrated in the diagrams to provide a context for understanding the core information work. The cases, which fall outside the system boundaries (the dotted and solid lines, e.g. in Fig. 6.2) are omitted, however, in the further analysis of the information processes. Similarly to the extra-system use cases, the use case diagrams include a set of actors and cases, which are not directly represented in the interview material. Thus the viewpoints of the exploiters (Fig. 6.2), consumers (Fig. 6.7), students (Fig. 6.11) and developers (Fig. 6.13) are perused strictly from the archaeologists' point of view in accordance with the overall objective of the present study to work on archaeological information work from the perspective of archaeologist users (ref. introduction to Chapter 6). The use cases were typically crystallised during the discussions on the theme two covering the informants' work and information work.

The next step was to place the relevant information activities in each use case under a direct scrutiny. The interactions were explicated and classified according to the **3) faceted classification of interactions with information** introduced by Cool and Belkin [186]. The present use of the Cool and Belkin faceted classification scheme places a special emphasis on accommodating the entire spectrum of information interactions, in contrast to Cool & Belkin article [186], where the scrutiny is focussed on the seeking of information. The analysis focusses in the current study on the classification of the interactions from an information point of view. Therefore the related communication behaviours are omitted on purpose. The communication aspect is discussed from the perspective of the information object interactions. This sub-facet is used to describe the principal barriers and hindrances related to the interaction. Because the classifications are descriptive devices of non-isolated particular actions, their contexts and motivations require some further attention. Besides the omission of communication behaviours, the original scheme has been modified by augmenting it to incorporate an additional sub-facet of *Obstacles* in the

[3] "The Unified Modeling Language" (UML) is a language for specifying, visualising, constructing, and documenting elements of software systems. At the present the language is used also in business modelling and other non-software contexts (ref. [559]).

Facet	Sub-facet	Sub-facet	Sub-facet
Information behaviour Disseminate	**Method** speak, (show, discuss)	**Mode** Instruction	
Communication behaviour (omitted in the present study)	**Medium** -	**Mode** -	**Mapping** -
Objects interacted with	**Level** information and meta-information	**Medium** written text, speech, images	**Quantity** Set of objects
Common dimensions of information	**Information object** part	**Systematicity** systematic	**Degree** selective
Interaction criteria topic, authority	**Obstacles** training, information overflow, time		

Table 6.2: An example of the faceted classification of the "Give course" information interaction related to the academic teaching work role (ref. Section 166). For a description of the activity, ref. pp. 168.

Interaction criteria facet of classification. The purpose of the sub-facet is to add a further analytical precision to the criteria of interactions in order to elaborate the investigation of ecological dimension and of the purposes, meanings and values of information work.

The classification scheme including the addition of obstacles and removal of the communication criteria is summarised in table 6.2 using the "Give course" interaction of the academic teaching work role as an example.

An assumption is made in accordance with the information management perspective of the present study that the interactions relate primarily to a motivation to accomplish the use case. Concurrent divergent and contrary motivations are treated as anomalies from the system perspective, albeit their overall significance to the human information work is readily acknowledged. The acknowledgement of the goal orientation is doubled in the perusal of the classificatory scheme. Even though the classifications are used to describe the interactions, they focus the investigation to the aspects of information work, which are emphasised in the contents and the structure of the classificatory description.

The classification criteria, which are related to the interactions, are discussed with a reference to the framework of the characteristics of the information needs introduced by Line [492] and developed further by Nicholas and Martin [550]. The present study assumes that besides reflecting the characteristics of explicit information needs and the consequent activity, the framework is applicable to the description of the dynamics of the interactions in general.

It is important to note that the actual classifications of the information activities, which have been chosen to represent the interactions, are heavily dependent on the assumed perspective. Basically all of the interactions may be attached to several classes as they tend to involve interplay between multiple behaviours. Organisa-

tion of available information does usually precede the creation of new resources similar to that the access precedes the use and comprehension. The objective of the analysis is not, however, to attempt to represent the entire spectrum of the diversity. On average one to two interactions have been selected for each use case. The choice of focussing on a limited number of distinct interactions is based on an assessment of the *primary* (cf. 'primary work' in Section 2.5.2) purposes, values and meanings of the use case and the related work role.

The assessment and subsequent choices of the classifications are based on the empirical material gathered during the discussion on the second interview theme. The information interactions are discussed further in section 7.4. It is important to note considering the classification, that the facet titled as 'information behaviour' is more focussed than the understanding of the concept "information behaviour" assumed in the theoretical framework of the present study (ref. Section 2.7.3). The principal purpose of the information behaviour facet in the classification of Cool and Belkin, is to explicate the various information behavioural *activities* instead of the entirety of the information behaviour [186]. The facet describes the essential explicit behaviour of an actor, but as a classificatory device, aims rather to distill its constituent aspects rather than to cover its complexity.

Finally, the individual use case related spheres of the information sources are summarised in analytically constructed **4) information horizon maps** (about the method refer to Sonnenwald et al. [707][711]) of each work role to provide an overview of the landscape of the relevant information objects for the information activity of the particular role. The work role specific sections include both the information horizons map and a discussion about its specifics (see below, e.g. the information horizon map of an academic teacher, ref. Fig. 6.12). The information, which is presented in the maps, was gathered by combining the information acquired during the discussions on the interview themes 2 and 3. In contrast to the earlier applications of the method, the technique of working with information horizon maps is used here *to represent typified information horizons, which relate to the work roles, not to the individual actors*. The aim of the approach is to be able to articulate the shared components of the information source landscapes in the diverse archaeological information processes. The principal benefit of the approach is to move the scope of the perusal from the individual users to the level of work systems. Information horizons of the individual informants are discussed in more detail in section 7.2.

6.2 Field archaeology

6.2.1 Work role

The field archaeology work role comprises a whole range of duties related to the archaeological field work. The principal forms of archaeological field work are excavations and surveys. The purpose of an archaeological excavation is to investigate archaeological deposits on a site of archaeological interest. Typically the process consists of literally excavating underground or underwater archaeological deposits, which have been created by a gradual stratification of earth masses over the time [423, 1-9]. Surveys are investigations with a purpose of finding out archaeologically relevant features, sites and locations in a specific area of interest. Surveys may be conducted for research purposes in order to discover and map patterns of human occupation. For the administrative ends, surveys serve the purpose of the

identification of the areas, which are going to require archaeological attention before any present or forthcoming land use [423, 66][601, 8-10].

Most of the informants, who were involved in the field archaeology, worked as field directors or deputy directors. A considerable part of the personnel of the labour intensive field projects consists of archaeology students, hired general workers and volunteers, that is, of people being outside the scope of the current study [P]. Working as a field director requires profound understanding of the field work methodologies and, preferably, as comprehensive field working experience as possible. Experience on working with diverse archaeological materials and general managing skills are also highly valuable. The formal qualifications, which relate to the field archaeology role typically comprise a graduate degree in archaeology, or a comparable education and experience.

According to the implicit general opinion of the informants, the field archaeology was perceived to be the principal and the most typically 'archaeological', work role. Other duties were clearly expressed to be secondary to the "proper" archaeological work conducted in field in the form of an excavation [A, B, C, D, N].

6.2.2 Work process

The duties of the field director begin simultaneously with a field project [D, F, Q]. In Finland and Sweden, almost all archaeological excavations and surveys are a result of communal and private land use i.e. *exploits* [C,N,P,O,W]. This branch of archaeology is referred to as *rescue archaeology* in Britain and *salvage archaeology* in North America [211][423, 5]. Research excavations launched on a purely scholarly interest are in a clear minority, mostly because of the lack of funding [C, J, P].

Basically all significant exploits are preceded or should be preceded by an archaeological evaluation on the basis of the national cultural heritage legislations [C, J, P, W]. An evaluation consists of a consultation of earlier information on the archaeological importance and potential of the site, which may be complemented with a field survey. In case of a limited exploit and a relatively minor probability of eventual archaeological concerns, an adequate measure might be to place an archaeologist to supervise the work and to be ready to intervene, if something important turns up [J, P]. If a location is considered to be of archaeological importance in the first place, the possibilities to alter the land use plans are considered usually as the first measure to minimise the eventual disturbance [C, J, P, W]. Sometimes the site may be saved altogether, but almost invariably, the extents of the necessary research and salvage efforts can be reduced [C, J, P, W]. Everything which can not be saved, but is still considered to be important, is investigated in an excavation prior to the exploit [C, J, P, W].

Research excavations and surveys differ from the rescue archaeology mainly with respect to the scope of their objectives. The primary purpose of a research motivated field work is to gather material to address specific scholarly and scientific questions. Project may be initiated by the archaeologist, who is herself conducting the field work. Alternatively, the contractor might be a landowner, an individual or an organisation (e.g. a municipality, trust or a congregation, ref. [540]), which is interested to sponsor investigations on a particular site. Most of the research excavations and surveys are initiated by archaeological research projects, archaeology departments of different universities, museums and heritage boards (e.g. [786][370]).

Prior to the field work, the appointed field director commences a basic back-

ground work in cooperation with a supervisor, who is appointed from the staff of the responsible archaeological authority [C, N, P]. Depending on the available time, the effort may be confined to include only the very basic preparations or to consist of a more extensive study [A, D, F, J, N, O, Q, W].

Subject to the division of labour, the field director might also be responsible for a number of administrative duties such as preparing the contracts, hiring labour, arranging materials and tools, and renting premises for the project [cf. O and P]. In most cases a permanent functionary of an archaeological authority takes the responsibility of the overall project management and frees the field director to concentrate on the practical work on the site [C].

During the field season, the director is responsible for supervising the survey or excavation work. The practical work consists of the gathering and storing archaeological material and of various managerial duties of the project. The director is responsible also for all of the interpretative decisions and of the organisation of the work in a predetermined schedule. Considering the scope of the entire project, the principal objective of the effort is to document the site as well as possible, and to preserve all archaeologically interesting material [A, J, O].

The size of the staff depends on the scale and the schedule of the project. Contractors, such as museums, archaeological research authorities and commercial enterprises use standard formulae for calculating the costs and staffing. Larger excavations in old cities are typically very labour intensive, because of the amount of the archaeological material. In smaller excavations, which relate, for instance, to a limited piping works, the whole project may be executed by the field director alone, possibly aided by an excavator [O, P]. Typical administrative surveys are carried out alone by an individual surveyor. One of the informants remarked that it might be beneficial to work in pairs, because of the subsequently increased effectiveness. Increasing the number of the involved surveyors would, however, increase the costs of the survey [F].

After the field season, the work continues with the processing of the retrieved materials for storage, and subsequently with preparing a report on the basis of the investigation. A rule for allocating time to field work and post-excavation work varies between 1:1.5 and 1:2 depending on the expected amount of finds and the complexity of the site [F, P]. A frequent complaint expressed in the interviews was the tightness of the budgets. According to the informants, it is not out of the ordinary that the financing proves to be inadequate for a comprehensive work on the field. Even more typically, the tightness of the budgets affects the reporting. Some of the field archaeologists complained also about the implicit expectations to finish the reports on one's own good time after the termination of the clearly inadequate funding. An uncompleted report would result in a bad reputation and deteriorating job opportunities [D]. Some informants remarked, however, that theoretically, the calculatory levels of funding should be relatively adequate, if nothing notably unpredictable happens [D, F, O, P]. In practise, the exceptions are not, however, very uncommon.

Most of the archaeologists, who work mainly in the field duties, are employed on a project basis with external funding [C, P]. Short contracts of the staff members and the impossibility of a feasible distribution of labour were considered to be a severe drawback [C, P]. From the field archaeologists' point of view, the short term contracts combined with low wages were a highly unsatisfactory combination [A, B, C, D, E, F, G, O, P, T].

Conspicuously the major source of critique of the informants was the infrastruc-

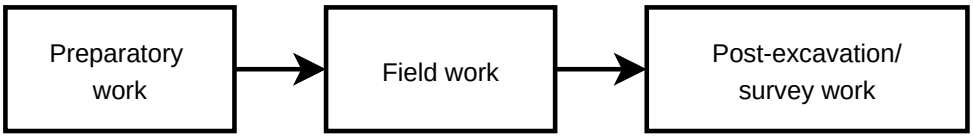


Figure 6.1: Work flow model of archaeological field work

ture of the archaeological operations. Low wages, unsatisfactory contract periods and a general lack of resources were considered to be the most constituent problems [C, P, W]. The field work itself was perceived to be highly satisfactory. Only one informant remarked on the potentially harsh conditions of the outdoor work during the cold seasons [O] as a negative side of the archaeological work. None adduced any substantial criticism on the archaeological work itself. The indicated positive sides of the field archaeology related principally to the multifaceted nature of the work [P, H] and the possibility to appease the curiosity of one's own and of the public on the human past [B, C, D, E, F, G, J, K, L, O, P, Q, S, T, V, W, X].

A schematic layout of the work process may be represented as a three-phase flow model illustrated in figure 6.1. The top-level process is significantly linear. Similarly, the individual phases are well distinguishable from each other in terms of the tasks and duties.

The principal actors and interactions of a generic field project are summarised as two root definitions: the one of a rescue archaeological field work and another of a research archaeology project. The key stakeholders of a rescue excavation are an exploiter, a field archaeologist, who directs the field work, and a supervisor, who is appointed by the archaeological authority responsible for the site. Root definitions are presented according to the CATWOE[4] criteria of the principal actors in a generic field work project from the field directors point of view.

6.2.3 Interactions with information[5]

The purpose of a rescue archaeology effort is to identify and document archaeological sites, and subsequently to produce a report consisting of the documentation and interpretation based on the findings. The report acts as a basis for the future archaeological research and as an administrative document, which provides information on the importance and the future prospects of the investigated area or site. The focus of investigations is to conserve adequate information about a site for the future scholarly needs and to present an evaluation for cultural heritage administrators to make decisions about necessary protective actions.

Due to the slightly different motivations of starting an archaeological survey or an excavation of an academic interest, the information activity differs between the research archaeology and the rescue archaeology. The emphasis of the both is in the identification and documentation of the archaeological material. The ambitions regarding the results and their immediate informativeness tend to be more detailed in the academic efforts. Apart from providing an adequate documentation for the future use, the research motivated projects are directed towards addressing the present information needs and interests in a more explicit manner than the rescue investigations.

[4]Ref. Section 6.1 for the description of the CATWOE analysis.
[5] The interactions are discussed in more detail in Section 7.4.

Field director (archaeologist)

Customers	Archaeological heritage administration (general public)
Actors	Me
Transformation	Excavation / survey
Weltanschauung	It is important to carefully excavate / survey the designated area to retrieve as much information about the site and to sufficiently document the findings.
Owners	Archaeological heritage administration (general public)
Environment	Archaeological site / research area
Field project is started in order to document an archaeological site before its exploitation. My duty is to perform the documentation as well as it is possible within the confines of the established schedule and budget. I am expected to deliver a report of the field work describing the process and the findings.	

Supervisor

Customers	State (exploiter)
Actors	Me (field director)
Transformation	Excavation / survey
Weltanschauung	It is important to carefully excavate / survey the designated area to retrieve as much information about the site as possible.
Owners	Archaeological heritage administration (general public)
Environment	Archaeological site / research area
Field work has to be done adequately to document all important archaeological features. Agreed schedule and budget have to be retained. Field director has to supply me with an adequately descriptive report of the findings.	

Exploiter

Customers	Me
Actors	Archaeologists (contractor and field director)
Transformation	Property (land area) becomes exploitable
Weltanschauung	I want to use the land (e.g. to build something)
Owners	Me (the property), State (archaeological findings); see section 5.4.2
Environment	The property
I am building an important house on my property. The archaeological sites in place have to be investigated, but the work has to be done as quickly and cheaply as possible to save my costs.	

Table 6.3: CATWOE-analysis of a generic rescue archaeology project (on the method, ref. Section 6.1)

Archaeologist

Customers	Archaeological research (individual researcher)
Actors	Me
Transformation	Excavation / survey
Weltanschauung	It is important to excavate / survey the designated area in order to answer specific research questions and to document the findings to secure as much information about the site as possible.
Owners	Me; contractor (if applicable); (general public)
Environment	Archaeological site / research area and its past context
I am excavating this site, because I am interested to find answers to my research questions. It is important to proceed in schedule, but most important is to find out applicable material and get significant results.	

Contractor (if applicable)

Customers	Me
Actors	Archaeologist
Transformation	Field work reveals new information about the past
Weltanschauung	I want to know more about the past and answer to a set of questions
Owners	(Possibly) Me, We (the general public)
Environment	Archaeological site and its present context (e.g. city, manor, quarter etc.)
I am interested in the past of this site, because it is probably in my possession. My judgement is that the site is of importance to the public. I am intending to serve the general interest with this contribution and to appear as a patron of archaeology.	

Table 6.4: CATWOE-analysis of a generic research archaeology project

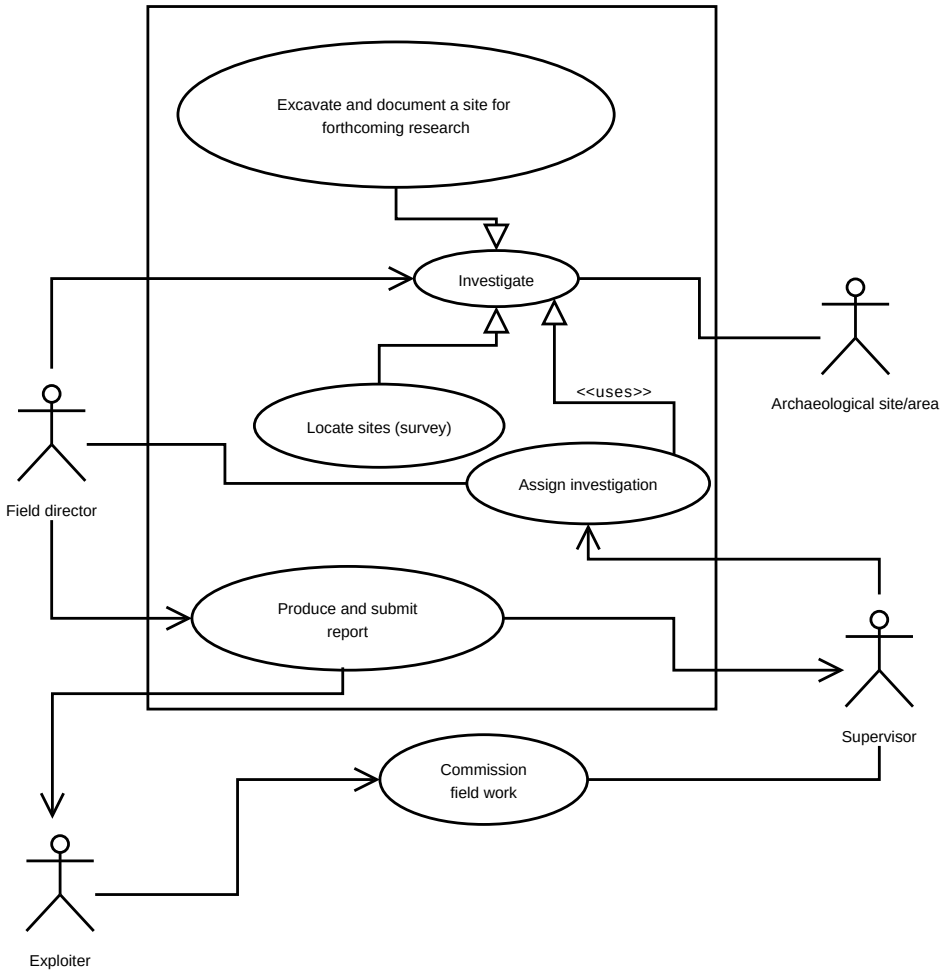


Figure 6.2: Use case diagram of a generic rescue archaeology project. For the notation refer to the UML specification [559].

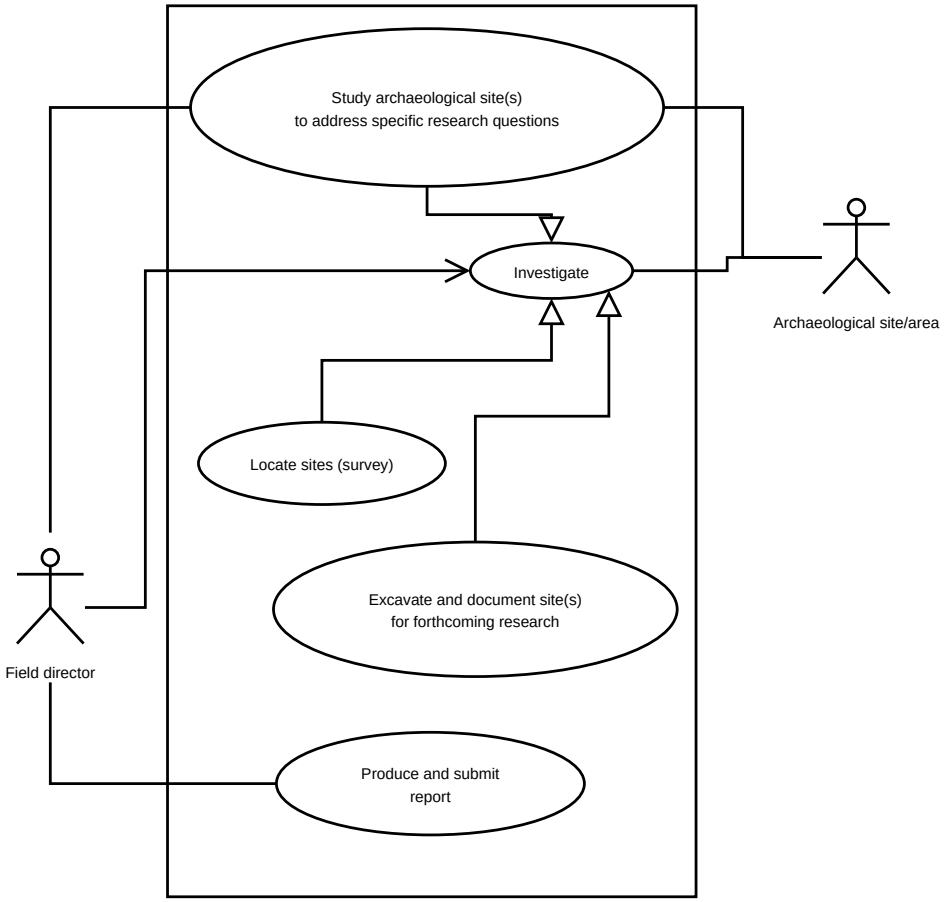


Figure 6.3: Use case diagram of a generic research archaeology project

Excavate and document a site for forthcoming research (Figs. 6.2 and 6.3): The documentation of an archaeological site for the forthcoming researchers is the single most important part of any excavation, because the excavation inescapably destroys the archaeological site once and for all. Excavating is essentially an act of *accessing* a physical information repository called the 'archaeological stratum'. Documentation of this repository is an act of *creating* a new resource called a report (see facets A.a, A.b, B.a, B.b below). "Investigation" is a generalisation of the specific use cases denoted as excavation and documentation (Figs. **6.2** and 6.3, ref. [559]).

In the process of documentation the finds are spared, but the original stratification of the deposits is lost. From the information process point of view, an excavation of an archaeological site is an act of *accessing* an information source by *scanning*. The process is described to be *systematic* and *exhaustive* (A.d, B.d). The notion is basically correct, but due to practical constraints, the comprehensiveness is limited by the availability of resources such as time, funding and tools (A.d, B.d). Similarly the principled notion is that everything should documented and every find will be collected (B.c). In practise, the comprehensiveness is limited by the capabilities of the individual diggers to discern the details and by their judgements on the relevance of the individual objects. Modern objects are often discarded alongside with the bulk of the uninformative finds found in masses. However, even if some objects are considered not to be worth preserving, their existence in the stratum is expected to be mentioned in the excavation documentation. In practise, the comprehensiveness of these mentions is bound to vary.

The following list explicates the use case "Excavate and document a site for forthcoming research" in terms of the faceted classification of information interactions [186]. The facets included in the present classification are *Information behaviour* (sub-facets: method and mode), *Objects interacted with* (sub-facets: level, medium and quantity), *Interaction criteria* (broken down to interaction criteria and obstacles).

A. **Excavate**

a. Information behaviour: *access*, Method: *excavating*, Mode: *scanning*

b. Objects interacted with: Level: *information*, Medium: *stratum*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *exhaustivity*, Obstacles: *time, resources, information overflow, (training)*

B. **Document**

a. Information behaviour: *create*, Method: *documenting*, Mode: *registering*

b. Objects interacted with: Level: *information*, Medium: *stratum*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *exhaustivity*, Obstacles: *time, resources, information overflow, (training)*

Locate a site (Figs. 6.2 and 6.3): Locating and inspecting a site on course of an archaeological survey is a multi-faceted process, which is based on the literature, maps and earlier research reports. Basically it is an act of *accessing* information on a site by *searching* and *recognising* the relevant pieces of data (see facets A.a, B.a below). Locating a site is a specific form of the broader use case called "Investigation" (Figs. 6.2 and 6.3).

The field work, which is relevant to locating a site, consists of contacting and interviewing occasional local informants and conducting field walking (i.e. surveying an area of potential interest by walking) in potentially interesting areas (B.b). The work involves primarily *searching* and *recognising* archaeological sites (A.a). Information sources include both *information* (sites, facet A.b) and *meta-information* (literature and other secondary information, facet B.b). Sites are inspected as a *whole*, but the process of selecting potential areas where to look for new sites involves careful *sampling*, which is based on available information on the local area and the previous experiences of the surveyor (A.c). The main criteria, which confine archaeological surveys, are the available time versus the dimensions of the survey area and the estimated importance of the expected findings (d).

A. Interactions with primary source material:

a. Information behaviour: *access*, Method: *searching*, Mode: *recognition*

b. Objects interacted with: Level: *information*, Medium: *physical sites*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *sampling (systematic)*, Degree: *selective (exhaustive)*

d. Interaction criteria: *time, importance, potential*, Obstacles: *time, resources, information overflow, (training)*

B. Interactions with secondary sources:

a. Information behaviour: *access*, Method: *searching*, Mode: *recognition*

b. Objects interacted with: Level: *meta-information* , Medium: *image, written text, drawing, photograph*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *sampling (systematic)*, Degree: *selective (exhaustive)*

d. Interaction criteria: *time, potential, subject, authority,* Obstacles: *time, resources, (information overflow)*

Assign excavation/survey (Fig. 6.2): An important duty of the supervisor of an archaeological investigation is to *search* and select (a,c) staff for the projects. Basically all professionally qualified archaeologists are proficient in conducting an investigation. Yet the breadth of expertise (b, d) concerning the different aspects of the site and expected finds is important for the success and especially for the comprehensiveness of the results. Assigning a project is a task, which involves *searching* and *recognising* suitable personnel (a). All project workers and the permanently employed archaeologists among the interviewees had some sort of an explicit or an implicit list of potential contacts (*meta-information*). Besides the formal data, the selection process is guided to a high degree by the personal experiences, contacts and earlier experiences of the candidates.

a. Information behaviour: *access*, Method: *searching*, Mode: *recognition*

b. Objects interacted with: Level: *meta-information*, Medium: *written text*, *personal experience, speech*, Quantity: *one object*

c. Common dimensions of information: Information object: *whole*, Systematicity: *sampling*, Degree: *selective*

d. Interaction criteria: *person, authority*, Obstacles: *appropriateness, training*

Study an archaeological site to address specific research questions (Figs. 6.3): Study of an archaeological site for academic research purposes (cf. Figs. 6.2 and 6.3) does not differ in a considerable manner from a rescue archaeology operation, when it comes to information process. Besides the requirement to produce an adequate documentation of the site, the interaction is guided by the generally somewhat more precise and explicit research questions (than a rescue excavation) and the special qualities of the site (A.d, B.d).

A. Excavate

a. Information behaviour: *access*, Method: *excavating* , Mode: *scanning*

b. Objects interacted with: Level: *information*, Medium: *stratum*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *research question, subject, quality*, Obstacles: *time, resources, quality, (information overflow, training)*

B. Document

a. Information behaviour: *create*, Method: *documenting*, Mode: *registering*

b. Objects interacted with: Level: *information*, Medium: *stratum*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *research question, subject, quality*, Obstacles: *time, resources, quality, (information overflow, training)*

Produce and submit a report (Figs. 6.2 and 6.3): Producing and submitting a report of an archaeological project is in essence an act of *creating* information (a) and enabling its preservation in a central archive. The format of a report is regulated by the national archaeological authorities, which causes some discernible variation from one country to another. The primary layout is, however, rather consistent. A report is a *compilation* of a description of the excavation process, a survey of the related literature and an interpretation of the results of the investigation. The description is followed by a catalogue of the finds unearthed during the project, a list of photographs, plans, drawings and samples. The most important findings and implications are often summarised in a separate short introductory chapter located in the beginning of the report. Besides the report document itself, the finds,

samples, photographs, journals, plans and drawings are submitted to the national archaeological authority for preservation (a, b, c). Basically the report is expected to be a *systematic* and *exhaustive* document, which covers the facts about the site and the investigation process (c). The actual procedures depend on the excavating institution, location of the site, its age etc., but the overall process is closely similar between the different institutions.

The excavation and survey reports differ in a one fundamental manner. Because an excavation is a destructive process, the excavation report is a reproduction of the excavation process, but it is also the only remaining reconstruction of the site itself. Even though a survey report is a unique document of the survey time state of the conservation of the sites surveyed, it is not meant to function as a full surrogate. It is closer to a complementary than a unique source of information. In this light an excavation report is closer to *information* and a survey report is closer to *meta-information* when it comes to the classification of the objects of interaction. The distinction is not, however, exclusive, because the process of surveying is unique (which makes the report *information*) and an excavation is not always completely destructive (b).

a. Information behaviour: *create*, Method: *write, draw*, Mode: *compilation*

b. Objects interacted with: Level: *information* and *meta-information*, Medium: *image, written text, drawing, photograph*, Quantity: *database of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *none*, Obstacles: *time, resources*

6.2.4 Information horizon[6]

Even though the information interactions and the criteria vary considerably within the field archaeology work role (ref. the information interaction classifications above), the information source use remains remarkably similar between the different kinds of field projects. The primary source of information of a field archaeologist is observation (ref. Fig. 6.4). Maps and reports from the earlier excavations and surveys of the investigation area are the most important secondary material. Field archaeologists rely on institutional sources, available local sources on the site, and occasionally on some nearby libraries and archives. Personal communication is also of a significant importance. Place and site names tend to function as the primary point of entry to this material [D, F, O, Q, W].

The second-most important sources of secondary information are the eventual direct contacts with colleagues, both with the ones with some previous experience of the area of interest, and the ones with experience on similar sites and materials [D, F, O]. Depending on the available resources, the basic information seeking is typically complemented with a browsing of the general works of local history and relevant, previously known subject literature [D, F, O, A, W]. Surveys typically involve more extensive and intensive searching of various information sources than

[6]The notation of the information horizon maps consists of ordinary (dotted squares) and entry-point information sources (the ones typically used first in information interactions; marked with solid squares), links between the sources (arrowed, if a prevalent sequence of use has been identifiable). The arrow and line indicate the position from which the horizon is approached examined by a representant of the work role.

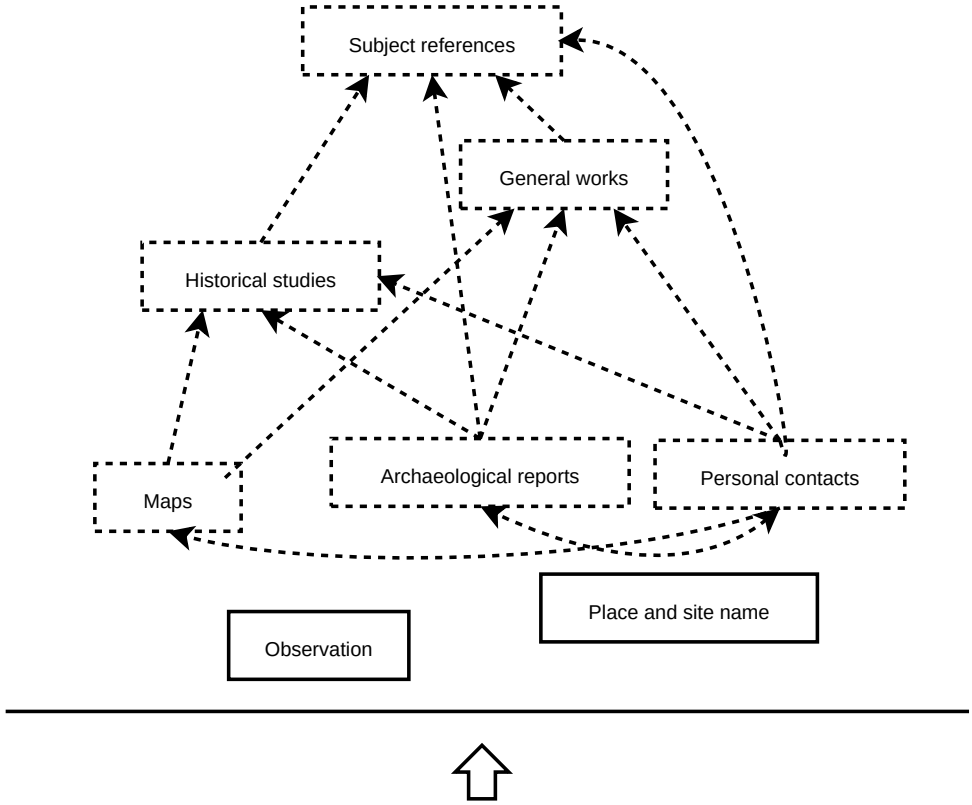


Figure 6.4: Information horizon of the field archaeology work role

the excavations. The complementary sources may comprise archival material, interviews, local literature, journals and newspapers [F]. Even though the informants did emphasise that all kinds of information is potentially valuable, it became clear that (if available) the archaeological literature holds the most potential and it is preferred above other sources.

6.3 Antiquarian

6.3.1 Work role

The term antiquarian is used here to refer to an archaeological work role, which comprises collection management and study of archaeological objects. Equivalent title "antikvarie" (Swed.) is used in Sweden of all archaeologists working in museums [R], but here the antiquarian profile is used in a slightly more confined meaning. In the national museums and heritage boards, the collection management staff concentrates primarily on collection related duties and has permanent positions. Smaller institutions may have only one person responsible for the entire collection, the antiquarian may have several parallel duties besides the collection management [O, P] or the antiquarian duties may have been distributed among the available staff. In the larger institutions the collection management may be distributed among a number of people with expert knowledge of specific types of (e.g. me-

dieval, Iron Age or Stone Age) materials [I, O, P, R, V].

Collection management duties are typically preceded by studies and research of specific artefacts. Broad knowledge of artefacts and archaeological materials is an advantage. Formally all informants who worked in antiquarian role, were educated as archaeologists. Special expertise in artefacts was gathered primarily by practical experience, focussed courses and own research. Most of the informants indicated also a rather deep affective relationship with the archaeological artefacts. The humans of the past were perceived to become especially 'close' through a direct manipulation of their preserved belongings [I, R, V].

6.3.2 Work process

An antiquarian is seldom engaged in only one work process. The work consists of parallel tasks relating to collection management, supervision, cataloguing, customer service and various expert duties. Typical customer at the collections department is a researcher who wants to inspect a specific corpus of archaeological material or a specific artefact known from another, for instance, literary source. The researcher may be interested in a specific location and excavation, such as the excavations at the Kvarnbacken site on Åland. On the other hand, her interest may concern a specific type of object such as the Viking Age swords from a larger area. The latter kind of a request is often posed by researchers, when they are collecting material for a thematic research project, or by exhibition curators looking for artefacts fitting to an exhibition theme. Queries do also come from ordinary people, interested, for instance, in the materials originating from their own home town, or in something resembling artefacts they have seen before [I, R, W].

To avoid transport damages, all artefacts are in principle, available for examination at the specific museum where they are stored [I, P, R]. In spite of the typical rule of avoiding transportation, artefacts are loaned for display to various exhibitions around the country and abroad. Loan lists are based on the requests made by exhibitors, but the final decision of lending an individual artefact is conditional, for instance, to their availability and state of conservation [I, R W]. Besides for a primarily academic interest, the artefacts are consulted for administrative and evaluative purposes [I]. The decisions to launch excavations and surveys, and the subsequent pre-excavation preparations may involve consultation of the earlier findings [D, O].

Besides the use and consultation of the collections, the collection management work comprises also storing new finds from recent excavations, catalogue maintenance and supervision of the collection. The physical condition of each artefact is inspected upon arrival and monitored thereafter. The decaying ones are sent to conservation. The schedule of the work depends on the availability of resources and the assumed priorities [I, P]. The management work comprises also development of the activities, even though the available resources for an extensive organisational development were expressed to be in most cases rather limited [I, R, V]. In spite of the similar comments of both Finnish and Swedish colleagues, it became apparent that the Swedish collection managers have significantly better resources for their work.

The analysis of the work process of the antiquarian role reveals two primary stakeholders with potentially diverging viewpoints on the work system: 1) the antiquarians who manage the collection and 2) researchers (being either professional or amateur) who have interest in the artefacts. The root definitions and the process are explicated in a corresponding manner to the field archaeology work role (ref.

Sections 6.2 and 6.3).

6.3.3 Interactions with information

The information activity of an antiquarian comprises the issues of maintenance and use of archaeological collections. The two activities are in many aspects contradictory to each other. Preservation would benefit of a minimal use, but because the collection exists to serve the community of researchers and on a more general level, the entire society, it has to be open for users.

Both the user service on site and lending outside require similar meticulous registering and monitoring of all artefacts and their precise location. Besides making the artefacts available for research and display, the antiquarian work consists of consulting researchers, general public and officials in need of information on individual archaeological finds or on the entire collection.

Besides being conservative activity, the antiquarian work orients towards the current developments in the archaeological research and in the science of preservation. Archaeological collections are expanding all the time, because of the investigations, which accumulate new material. Besides the information relating to the new additions, an antiquarian has to be broadly aware of the current research, which relates to the existing collection. Similar sensitivity is needed about the recent developments in storage techniques, conservation and research methods.

Retrieve specific artefacts (Fig. 6.5): Retrieving specific artefacts is a relatively straightforward process of *accessing* a *specific find* or a *set of finds* (c, b) from the storehouse (a). For instance, the collections department at the National Board of Antiquities (of Finland) specifically requires that all requests have to be made on its call number, which makes the retrieval process rather uncomplicated. If the call number is unknown, it is still possible to retrieve an artefact with a relatively little browsing if its place and date of discovery is known. Identifying and retrieving an artefact with a reference to an image or to information about its physical characteristics, is more difficult. The success depends largely on whether the antiquarian knows personally the artefacts and remembers, where it is located (d). The interaction concerns mainly *information* (the artefact), but involves *meta-information* as it is needed to access the correct material (b).

a. Information behaviour: *access*, Method: *searching*, Mode: *specification*

b. Objects interacted with: Level: *information*, Medium: *physical objects*, Quantity: *one object – set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *accuracy, call number*, Obstacles: *search tools, information overflow*

Retrieve artefacts of specific kind (Fig. 6.5): Another type of a typical query to an antiquarian, is to ask (for *access*) about specific kinds of artefacts, which belong to a collection (a, b, c). The type of an artefact may be such as “medieval chess pieces”, “Viking age swords from central Sweden” or “16th century glazed earthenware pottery”. The interaction criteria of *representativity* denotes the idea that all matching artefacts are treated as representations of the descriptions and queries

Antiquarian

Customers	Researcher, general public, exhibitors; (future generations)
Actors	Me
Transformation	Retrieval and display (lending) of collected material; collection management tasks as supportive measures
Weltanschauung	It is important to store and preserve artefacts for the good of the researchers and the general public in order to be able to disseminate knowledge of the human past and simultaneously ministering that the use and display of the artefacts does not deteriorate them.
Owners	Museum (state); General public; (Me)
Environment	Storeroom (institution)
I am taking care of the archaeological collection to preserve it for future generations and to give the researchers and the interested public access to it. My main concern is to keep the artefacts in good condition, while serving my guests (i.e. customers) as well as possible.	

Researcher

Customers	Me (general public through the publication of my results)
Actors	Antiquarian; Me
Transformation	I get the materials I need in the task of answering my research questions.
Weltanschauung	The collections exist to provide me (and my colleagues) with the material for my (our) research.
Owners	Museum; Collection managers
Environment	Institution(s) owning the artefacts
My job is to conduct research on the stored materials and tell the general public about past human life and activities. Collections are worthless if they are inaccessible to me. Special care should be taken to develop their usability for (my) research purposes.	

Table 6.5: CATWOE-analysis of a generic research archaeology project

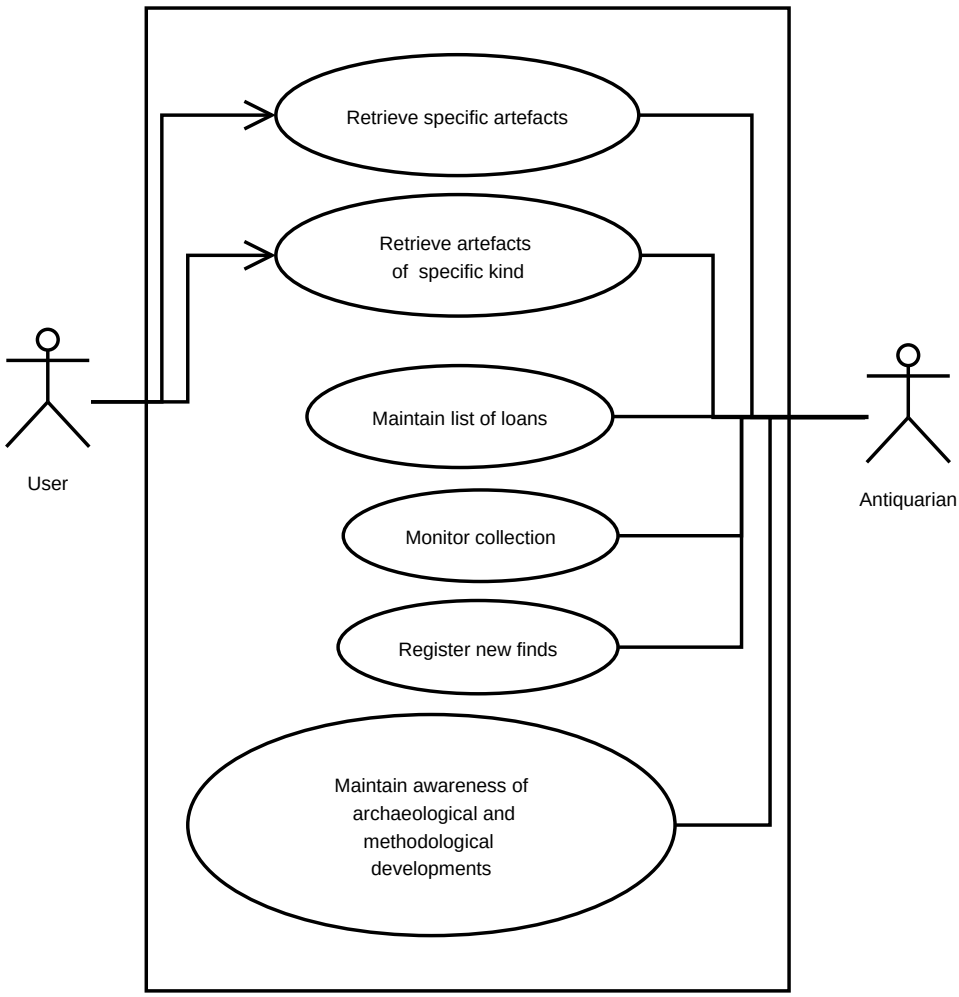


Figure 6.5: Use case diagram of antiquarian work role

submitted by the 'clients' (d). The antiquarian attempts to track down and *recognise* an artefact or a set of artefacts, which coincide as precisely as possible with the query. *Meta-information* is used to access the *information* (b). Searching according to the type and physical characteristics of an artefact is possible although not exhaustively as the computerised catalogues tend to cover the collections only partially. New finds are generally registered in electronic collection databases, but due to the lack of resources, few plans do exist for the conversion of earlier catalogues. Further difficulties to access the finds are caused by the varying interpretations of the functions and designations of the artefacts over time (d).

a. Information behaviour: *access*, Method: *searching*, Mode: *recognition*

b. Objects interacted with: Level: *information* (by using *meta-information*), Medium: *physical objects*, Quantity: *one object* to a *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *random* and *systematic*, Degree: *selective*

d. Interaction criteria: *representativity*, Obstacles: *time, resources, information overflow, lack of meta-information, (training)*

Maintain list of loans (Fig. 6.5): Managing the movements of the artefacts, which are stored in collections, is a vital part of the collection management effort (i.e. a database, see facet b). This work is necessary also to ensure an effective retrieval of the artefacts. In spite of the benefits of using an integrated system for cataloguing the artefacts and maintaining a list of loans, for legacy reasons, the two functions are in many cases maintained in parallel systems. An information system with quick and straightforward search and retrieval facilities is needed to manage the information on whether an artefact is loaned out to an exhibition, is being inspected at the moment by a researcher, is in the shelf or in conservation, or has been lost sometime in the past. The interaction is perceived as *access*, because the maintenance of the list of loans is essentially a (*meta-information* level) bi-product and documentation of a series of 'accessings' (a, b). It is necessary that the work is *systematic* and the list is updated constantly (c). As a whole, a rather rudimentary functionality is sufficient for the management function. The ease and quickness of use were perceived to be essential features of the system. Besides a very basic textual information, only the inclusion of thumbnail images was considered as a useful functionality.

The Museum of National Antiquities in Sweden has implemented recently an information system for collections management, which functions as a comprehensive tool for collections related work. The National Board of Antiquities has implemented a comparable system for collections management in Finland. Due to the incomplete migration of existing repositories the both institutions work at the moment with several parallel manual and digital systems for inventory and collections management. Overall comment on the Swedish system (expressed by its users) were principally positive, whereas the informants, who had working experience with the Finnish system, were more reserved. The main source of the criticism of the both systems seemed to be their excessive comprehensiveness and complexity in comparison to the perceived immediate needs and resources available for their use (d).

a. Information behaviour: *access*, Method: *searching*, Mode: *recognition*

b. Objects interacted with: Level: *meta-information*, Medium: *text (images)*, Quantity: *database of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *exhaustivity*, *accuracy*, Obstacles: *resources, information overflow*

Monitor collection (Fig. 6.5): Monitoring (i.e. *accessing/scanning*, see facet A.a) collections (A.b, B.b) is performed mostly together with other collection management activities. The overall physical state of the collections is managed largely through controlling the atmosphere in the storerooms. Different materials are held in separate storages, because they require different levels of humidity and temperature for optimal preservation. The individual finds are typically inspected, when they are asked to be seen by a researcher, or when they are about to be loaned out. A systematic surveillance of the individual artefacts is not usually possible due to the size of the collections (A.c, B.c). The most sensitive materials are controlled on a more regular basis (A.d, B.d).

A. Monitor

a. Information behaviour: *access*, Method: *scanning*, Mode: *recognition*

b. Objects interacted with: Level: *information*, Medium: *artefact*, Quantity: *one object* (*set of object* in case of monitoring the entire storeroom)

c. Common dimensions of information: Information object: *whole*, Systematicity: *random*, Degree: *exhaustive*

d. Interaction criteria: *sensitivity of materials,* Obstacles: *time, resources, information overflow, (training and knowledge about the special requirements of individual objects)*

A. Preserve

a. Information behaviour: *preserve*, Method: *management*, Mode: *maintenance*

b. Objects interacted with: Level: *information* (by using meta-information), Medium: *artefact*, Quantity: *set of object*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive (in practise selective)*

d. Interaction criteria: *sensitivity of materials, importance,* Obstacles: *time, resources, information overflow*

Register new finds (Fig. 6.5): Registering new finds is a task of the excavating and surveying archaeologists. Each artefact is studied and *evaluated* (B.a), described using a minimum common set of descriptors including the findspot, physical measures, weight, material, date and description. Furthermore,each artefact or a set of artefacts is assigned a catalogue number. The artefacts are thus *organised* by merging them to a collection (A.a). Antiquarians are responsible for receiving the finds, inclusion of the records to the archives and the collection management system and

delivering the objects to the magazine. The process involves an elementary control of the delivered material and records (A.a). Organisation and registration of the finds is *systematic* and *exhaustive* (A.c), while the overview of a set of finds is necessarily a more random assessment of a larger quantity of the finds (B.c). The accuracy of the work is highly dependent on the expertise and earlier experience of the archaeologist who is working with the finds (A.d, B.d).

A. Organise the finds to form a collection

a. Information behaviour: *organise*, Method: *merging*, Mode: *attach*

b. Objects interacted with: Level: *information* (by using meta-information), Medium: *artefact* and *database record*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *accuracy, exhaustivity,* Obstacles: *resources, information overflow*

B. Assessing the find

a. Information behaviour: *evaluate*, Method: *conforming*, Mode: *recognition*

b. Objects interacted with: Level: *information* with *meta-information*, Medium: *database record* and *artefact*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *accuracy*, Obstacles: *time, resources, information overflow, (training)*

Maintain awareness of archaeological methodological developments (Fig. 6.5): An antiquarian should be extensively informed of the technology, methodology and archaeology related developments concerning the area of her expertise and responsibility. Depending on the availability of resources, some institutions have means to appoint antiquarians to specialise to certain periods or categories of artefacts. Otherwise the collection managers generally attempt to maintain at least a working awareness of the broad discussions concerning their collections by reading (i.e. *accessing*) journals, dissertations and collection catalogues (a, b, c, d). Special difficulties have been posed by the expanding illegal trade of antiquities, because an antiquarian who is working for the antiquities authority in a Nordic country, is seldom educated comprehensively enough in e.g. Asian, African or South-American archaeology, to be able to give authoritative opinions on artefacts, which originate from distant countries.

a. Information behaviour: *access*, Method: *scanning*, Mode: *recognition*

b. Objects interacted with: Level: *meta-information*, Medium: *written text, image, speech, video*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *random – systematic*, Degree: *selective*

d. Interaction criteria: *importance, authority, contingency*, Obstacles: *time, resources, information overflow, (training)*

6.3.4 Information horizon

The information horizon of an antiquarian (Fig. 6.6) is focussed around the users of archaeological collections and the central registry of artefacts. The initial impetus for the most of the information activity comes from the users of the collection either as direct questions, requests to see, and when it comes to the museum exhibitions, to loan the artefacts. The antiquities registry, which contains all objects of the collection was described in all responses as the most important information repository for the antiquarian work role [I, O, P, R, V].

The initial searches are typically done in the most recent inventory and collection management system to check whether some of the requested objects had already been entered into its database. Due to the computerisation of the new systems and the consequent ease of access to their data, the new systems tend to be also the fastest to use, and thus the fastest to provide a satisfactory (even if not exhaustive) set of information for the antiquarian [I, R, V].

The bulk of the information activity resides in a matrix formed by personal communication with the customers and colleagues, the antiquities registry, the inventory database, archaeological literature and the artefacts. The significance of the centralised database systems was emphasised by all antiquarians. The newest systems incorporate a wealth of information with a direct relevance to the antiquarians work, which clearly enhanced the satisfaction of the users. The satisfaction showed up especially in the choice of words. Several of the informants referred the old system as a 'database' while the new one was called an "information management system" [C, O, I, V, W]. Besides the typical characteristic of being new, the 'better' systems were often implemented by specialists, who had special expertise in archaeology, in close cooperation with the users. An even more constituent characteristic of the 'better' systems was that they were directly tailored to the distinct work processes within individual institutions. A typical expression of dissatisfaction to a new system was that the system was designed for a neighbouring department or institution, and it did not accommodate well into the own, very special needs.

The most frequently used personal contacts were usually within the institution. The ease of calling or asking a colleague in person was preferred by all informants [I, P, R, V]. Email contacts were most typical with experts with whom no previous contacts had been established and with the colleagues who resided abroad. Second to the own institution, the most frequent contacts were the old fellow students and earlier colleagues. The ordinarily used archaeological literature consisted primarily of authoritative works, which gave a relatively broad, but still comprehensive overview of a theme or a group of artefacts. Antiquarians appreciated detailed archaeological general works of a period, and well laid out and comprehensive source publications of individual archaeological sites and themes. A typical exhaustive publication was indicated to be a precise and meticulously compiled dissertation [I, O, P, R, V].

Besides dissertations, the informants mentioned several general titles, which might serve as useful references for the interested general public. The interviewees defined as an essential characteristic of such a resource its legibility, and the authenticity (basically trustworthiness) of its factual content. Any other forms of popular media serve an antiquarian mainly in supporting an awareness function. They provide only seldom any true insights. Only rather infrequently the popular media manages to supply a useful starting point to the scholarly information on the subject matter [I, O, P, R, V].

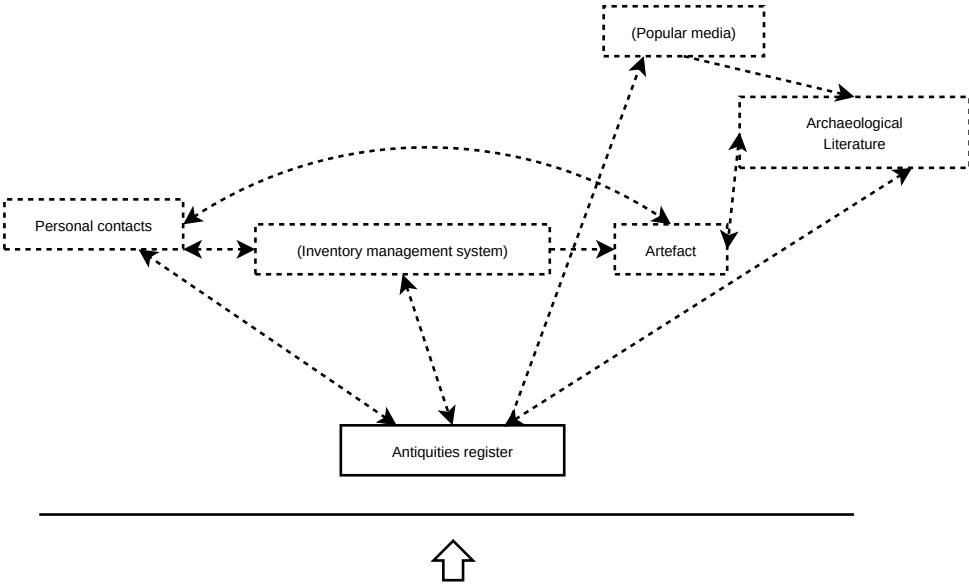


Figure 6.6: Information horizon of the antiquarian work role

6.4 Public dissemination

6.4.1 Work role

The public dissemination work role comprises a relatively large and heterogeneous group of duties related to the work in museums and comparable institutions. The public dissemination is pertinent for exhibition designers, planners, educators, writers, guides and editors. The role expects a broad understanding of archaeological materials, research activities, methods and results, and a competence to present archaeological knowledge to the general public.

Broadly understood, the public dissemination is a part of all archaeological work profiles. Researchers are involved in dissemination when publishing texts, which are eventually going to be available to the general public. Similarly a field archaeologist who answers a question of a bypasser, is involved in the same activity [D]. The proportion of explicit public dissemination varied considerably in individual work profiles. Academic researchers [H, Z] indicated minimal explicit participation in the popular archaeological sphere, while some of the museum professionals were almost completely involved in the dissemination [K, L].

Archaeologists, whose work profile comprise the public dissemination role indicated a strong interest to communicate archaeological matters and the human past to the general public. The composition of work profiles and available techniques and resources affect the necessary qualifications in different dissemination contexts (e.g. museum exhibitions, educational multimedia or popular magazine articles) [K cf. L]. Experience and education in museology, experimental archaeology or pedagogy represent a typical background with a general interest to the popular writing, visual expression and public presentation [E, K, L, O, P, V].

6.4.2 Work process

Like the collection management (Fig. 6.5), the public dissemination work is considerably heterogeneous. In spite of the variety of work tasks, it seems to be possible to make a broad classification. Dissemination typically involves 1) production of deliverables, 2) unidirectional dissemination of information and 3) bidirectional interaction with the public. The choice of media and the precise information products vary depending on the exact nature of each individual work profile.

In a museum environment, the bulk of the work consists of exhibition design and planning of related activities and materials, including workshops, demonstrations and publications. The work is typically centred around exhibition projects running parallel to each other. A project starts two-three years before the scheduled inauguration. The bulk of the activities concentrate, however, within a relatively short period of time immediately before the opening [K, L]. The schedule follows the budgeting cycle of the municipal and governmental bodies, which finance the museum.

An exhibition project usually begins with writing a synopsis of the planned display. The initial synopsis is worked in a group. The idea is outlined and confined to meet various practical and presentational prerequisites, and shaped to a manuscript [K]. The initial planning is followed by searching and borrowing archaeological material, which is appropriate for the exhibition. The availability of the suitable artefacts in own collections and in the collections nearby is often crucial for the eventual decision to include or exclude different themes and topics within the final exhibition. Finally, when the manuscript is ready and the artefacts have been tracked down, the physical design of the exhibition is finished and the exhibition is constructed. Extras such as courses, workshops, children's programmes and an exhibition publication or a catalogue, are worked simultaneously with the planning of the actual exhibition.

One-directional dissemination of archaeological knowledge is mostly done in a form of public lectures and guidings on archaeological sites [O, K]. Bidirectional interaction includes archaeological workshops and courses organised, for instance, by museums. The bidirectional interaction and the various forms of participatory dissemination have become increasingly popular. The popularity relates closely to the rise of visitor-centrism in museological theory [637]. In accordance with the paradigm, the professionals are working actively with the students, schools and ordinary people. The popular interest in the subject may be both archaeology related and practical (e.g. in the case of making historical handicrafts). Workshops are organised by professional archaeologists, who have been specialised in historical crafts. Equally typical are workshops organised as combined efforts. An archaeologist tells the participants about ancient crafts and artefacts, and a modern craftsman instructs how to make similar objects [K, L].

From the systems analysis perspective the public dissemination interactions involve two diverging viewpoints with dissimilar views on the inspected system. The viewpoints (*disseminator*, i.e. archaeologist, and the *consumer*) are presented in the adjacent use case diagrams. The 'users' of popularised information (denoted here as 'consumers' due to the commodity like nature of the popularised information) are called in reality with a variety of names, such as 'visitors', 'readers' or 'participants' depending on the contexts of reference.

Disseminator

Customers	General public
Actors	Me; in exhibition and bidirectional dissemination the customer i.e. "(museum) visitor" as a secondary actor
Transformation	Distillation and presentation of archaeological understanding of the past combined with other available information in a form, which communicates with the general public.
Weltanschauung	The people has a right to know about their past and of the results of the archaeological research. It is important to present the available information in a meaningful and communicative manner.
Owners	Museum (state); General public; (Me)
Environment	Museum exhibition hall; archaeological site; the society
My duty is to popularise archaeological research results to the general public. People are interested in the past and I have to shape the archaeological knowledge to such a form that it is educative, entertaining and easy to consume. The communicated matters and the methods of presentation should be connected to something actual, which is understandable to the public, both when I am writing a book and exploring the past together with the visitors in a museum. The most important thing is what the customer (visitor, reader, user) gets out of the presentation. The past is, in a material sense, a property of the state or the museum, but I feel that by large, it belongs to all of us. I might be working in a museum, *on situ* on an archaeological site, but always with the people for whom I am disseminating the knowledge.	

Table 6.6: CATWOE-analysis of the public dissemination work role (Disseminator perspective)

Consumer

Customers	Me
Actors	E.g. Museum (institution), museum guide, writer of a book (the book itself); in an exhibition and in a bidirectional dissemination I am a secondary actor
Transformation	I am having fun and I am learning interesting and exciting new things about the past while reading a book or visiting an exhibition.
Weltanschauung	Archaeology is fascinating and it is interesting to know about the ways of living in the past.
Owners	Museum (state); General public; (Me)
Environment	Museum exhibition hall; archaeological site; the society
I am interested in history and archaeology. It is thrilling and entertaining to know exciting things about the past, visit well-designed exhibitions and read interesting books. In a sense, I feel that I have a right to know about the results of archaeological research. It is the museum people's or archaeologists' job to tell me about the past in a way that I understand what they mean.	

Table 6.7: CATWOE-analysis of the public dissemination work role (Consumer perspective)

6.4.3 Interactions with information

Information activity, which is related to public dissemination, may be characterised as being somewhat fluid. The popular archaeological dissemination (including popular literature, public education, television documentaries and museum exhibitions) has multiple relatively established modes of communicating archaeological knowledge. In spite of the conventions, the practical process and goals of the popular archaeology are constantly under negotiation, thus resulting in equivocally conceptualisable information interactions. The special challenge of the public dissemination relates to its multiple functions as communication, education and entertainment [O, K].

The principal use cases consists of instances of a public dissemination professional producing new editions and versions of archaeological knowledge for popular presentation and the interactions relating to their reception. The empirical material of the present study indicated three essentially different dissemination interactions: 1) The first category comprises the production of a description of an archaeological subject. The focus of the interaction is to describe the past essentially for its own sake using appropriate media such as a book, an article, a television documentary or an interactive multimedia presentation. 2) The second type of interaction involves the presentation of a physical archaeological object. The characteristic, which makes this type of interaction distinct is, however, the attempt to make an object itself to contribute to the act of information dissemination. 3) The focus of the third category of interactions is in describing a present subject or phenomenon through confronting it with an archaeological subject. The three interactions are typically complementing each other in the various kinds of literary and visual publications and physical exhibitions and displays, making the distinctions, in a practical sense, somewhat artificial. From the information interactions point of view, the matrix of motivations becomes, however, the focal point of the

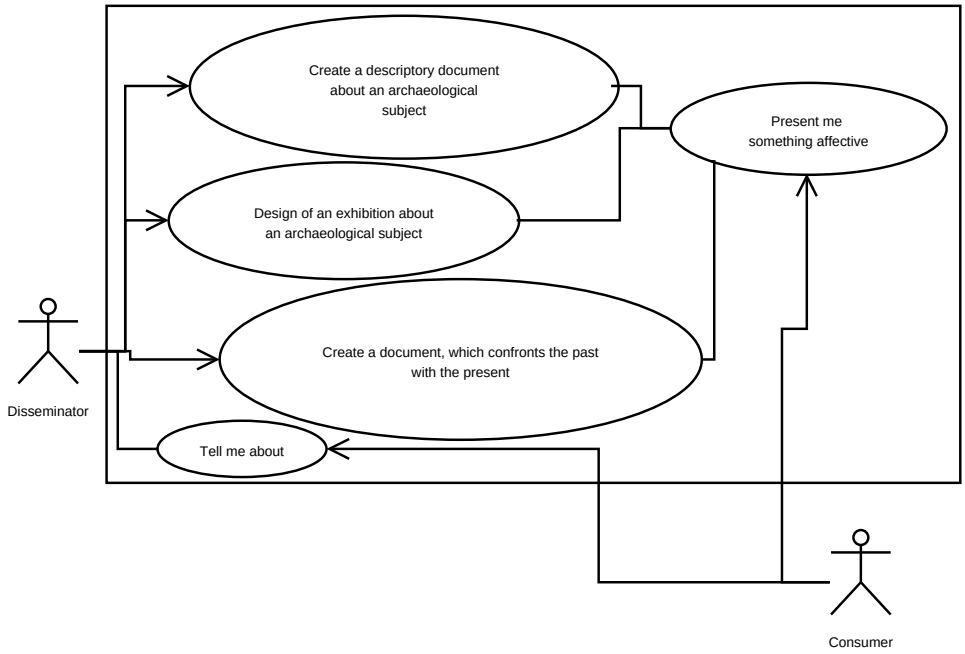


Figure 6.7: Use case diagram of public dissemination work role

interactions, which affects the source use and the procedures of information work.

The popular interest in archaeology may be divided to subject interest and affective interest according to the findings gathered during the interviews. Similarly to the information dissemination use cases, also the consumptive uses of archaeological information intertwine with each other. The lack of pure subject interest or a pure affective inclination for archaeological knowledge is evident. Despite the considerable variety of practical expressions of interactions, for instance, in the form exhibitions, guidebooks and TV documentaries, the affection related activity is assumed here to incorporate diverse motivations from general to an educational maintenance of cultural awareness, and to the forms of emotional interest in artefacts and past cultures.

The constituent criteria for information interactions in popular archaeology dissemination are on the one hand, the authority of the available information and on the other, an affective factor, called here the *subject attractiveness*. The availability of information in general, and especially of suitably intelligible and accessible archaeological subjects, varies considerably. Particularly the abstract subjects, such as the various aspects of religion and intellectual world, are difficult to be visualised and presented. Subject attractiveness, on the other hand, determines whether a subject might be able to interest someone. The factor is highly transient and contextual, thus making it difficult to explicate.

Create a descriptive document about an archaeological subject (Fig. 6.7): This abstract use case is used to refer to all information activity, which concerns the *creation* and production of popular archaeological books, TV documentaries, games, guides, brochures, data sheets, articles and public lectures (A.a). The fundamental denominator of all creative activity is that an archaeology professional attempts to produce an *approachable description* of an archaeological subject using appropriate

media without having the subject (e.g. ancient city) on the site of the presentation (e.g. at a museum) (A.b). The interaction concerned is essentially a *modification* of the already existing archaeological knowledge to a more intelligible form (B.a). The process involves, however, also secondary acts of creation of new information through interpolation and combination of existing scholarly information (A.a).

Popular archaeological publications are usually conceived either as continuations of scholarly publications or as independent publications, which relate to an event or a project. Conspicuously, many interviewees emphasised the importance of popular dissemination, even though only relatively few had engaged in this activity. For an academic researcher, a popular publication typically comes after the publication of a dissertation, book or an article on a subject with some popular potential. The popular document is thus typically an edited or rewritten version (*meta-information*) of the original, possibly elaborated with additional illustrations and more approachable layout (A.b, B.b). Production of exhibition, project and educational activities related popular archaeological material is an everyday activity in museums. For a museum and for a production company, which is engaged in popular archaeological dissemination, the impetus comes more often from an idea, which emerges from the context of the current activities or, which is presented by some individual. The idea is elaborated, more likely in a group than by an individual, during a process of writing a script and making of the final product (A.c, A.d, B.c, B.d). Otherwise the broad lines of the practical process of modifying and creating information resembles each other both in corporate settings and in museums.

A. Creation

a. Information behaviour: *create*, Method: *writing, drawing, filming, photographing (etc.)*, Mode: *combination, interpolation*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple*, Quantity: *one object* to a *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *authority, importance, topic*, Obstacles: *training, (knowledge) resources, appropriateness*

B. Modification

a. Information behaviour: *modify*, Method: *writing, drawing, filming, photographing (etc.)*, Mode: *contextualisation, clarification*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple*, Quantity: *one object* to a *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *authority, topic, importance, interest*, Obstacles: *training, (knowledge) resources, appropriateness*

Design of an exhibition about an archaeological subject (Fig. 6.7): The act of designing an exhibition about an archaeological subject varies only slightly from other *dissemination* related activity (a) when it comes to the related information process.

The fundamental difference is in the matter of making *an archaeological object* to speak for itself (b) in a constructed context of an exhibition or a presentation. In a publication, either a literary or a visual document is explicitly brought to a 'customer', while in the case of an exhibition or an archaeological site, the 'customer' comes to an archaeological object (b).

Designing an exhibition is a process, which involves a group of people. An initial idea is developed into a full presentation in a similar manner to the work in the museums and productions companies in general (ref. the previous use case above). A project group typically consist of a few persons including a responsible curator, a subject expert, occasionally an information and marketing specialist and a technical exhibition architect. The composition of a project group depends on the availability of staff and financial resources. The initial idea is worked to an exhibition manuscript. The crucial factors of the final layout are the chosen themes, the archaeological objects, which are obtainable for display, the general availability of relevant information, images and illustrations and the formation and functioning of the exhibition as a coherent 'ensemble' of individual themes (c,d).

a. Information behaviour: *dissemination*, Method: *presentation*, Mode: *contextualisation*

b. Objects interacted with: Level: *meta-information* (by using information as a focus of the presentation), Medium: *physical objects*, Quantity: *one object* to a *set of objects*

c. Common dimensions of information: Information object: *part – whole*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *importance, context, topic, outlook, subject attractiveness*, Obstacles: *information overflow, lack of information, time, resources, access (to objects), appropriateness (for display)*

Create a document, which confronts the past with the present (Fig. 6.7): According to the information gathered for the present study it seems that a large part of the popular dissemination of archaeology information is motivated by the will of purveying archaeological knowledge. The earlier view of the history as a teacher of the present and future has lost ground to scientificist and the postmodernist standpoints. The existence of a subjective contextualising value of the historical knowledge is still acknowledged. Especially in the popular dissemination, also the value of making comparisons between the past and the present is acknowledged as a demystifying asset. The act of confronting the past reality with the present, is essentially an act of *organising* information to make it more tangible to the public (a). The procedure is highly *selective* and depends on the criteria of *topic* and *appropriateness* for the purpose (c, d). The information objects referred typically consist of secondary sources created on the basis of the original information (b).

a. Information behaviour: *organise*, Method: *comparing*, Mode: *contextualisation*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple*, Quantity: *one object* to a *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *importance, authority, topic, subject attractiveness,* Obstacles: *training, appropriateness*

Tell me about (Fig. 6.7): According to the observations made by the interviewees, the most typical questions posed by the public to a museum guide or a lecturer circulate around rather concrete issues. The public interest typically concerns archaeological artefacts and especially archaeological work procedures [O], while the more *general notions* about past life and culture are of significantly less interesting (b). The process of emergence of the questions is highly contextual and thus, from the archaeologists' point of view, seemingly *random* and *selective* (c). From the information process point of view, the subject interest and its eventual satisfaction may be classified as an act of *comprehension* (a) where the constituent criteria are the *authority* of the expert and *attractiveness* of the subject matter. The interaction is constrained by that how the archaeologist can communicate and relate the topic to the actual context of the questioner (d).

a. Information behaviour: *comprehend*, Method: *read, listen*, *see*, Mode: *contextualisation*

b. Objects interacted with: Level: *information* with *meta-information*, Medium: *multiple*, Quantity: *(typically) one object*

c. Common dimensions of information: Information object: *whole*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *authority, subject attractiveness, topic,* Obstacles: *training*

Present me something affective (Fig. 6.7): Apart from learning, the popular activity with archaeology has a strong affective dimension. The subject has to be not only of interest, but it has to carry also elements of excitement and potential affective attachment. Mediating the affective of the past and of the archaeological knowledge is above all an act of communication. The communication does, however, trigger a secondary interaction of *information use* on a personal-contextual level (a). The information is not only used to produce factual 'informedness' of the archaeological subject, but also to actively *construct a cultural self-identity* (a, b). This kind of an information, which is suitable for the identity construction, depends on the user contexts (which are *random* from the archaeologists' point of view) and necessitates a careful *selection* of the information in order to make it coincide with the criterion of *appropriateness* for raising the affects (c,d). The activity may be perceived as secondary to the explicit knowledge centred information behaviour, but it bears a definite meaning as a fundamental motivation for engaging in the popular archaeological information (b). Therefore it is important to underline that the interaction is fundamentally an information activity, although it does not attempt to address any typical information activity related goals.

a. Information behaviour: *use*, Method: *interpretation*, Mode: *identity construction*

b. Objects interacted with: Level: *meta-information* with *information*, Medium: *multiple*, Quantity: *one object* to a *set of objects*

c. Common dimensions of information: Information object: *whole – part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *appropriateness, authority*, Obstacles: *appropriateness*

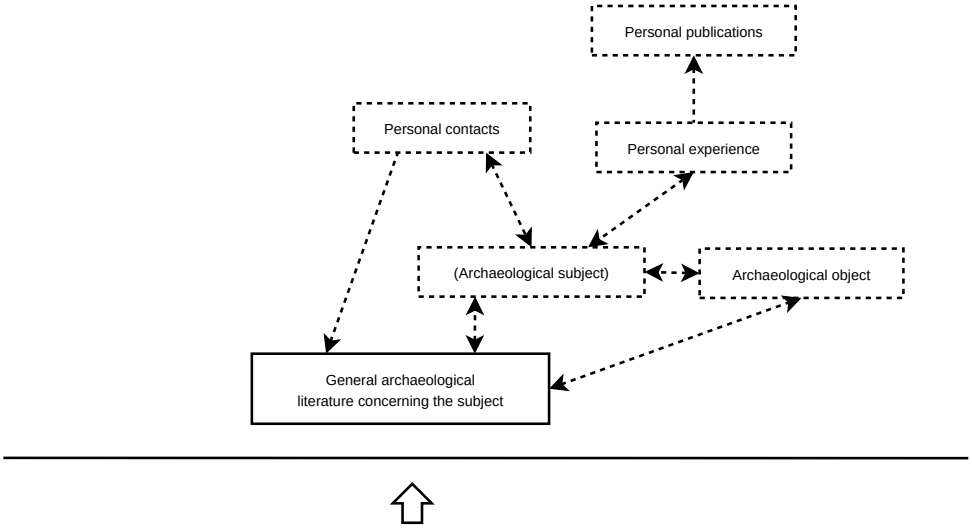


Figure 6.8: Information horizon of the public dissemination work role

6.4.4 Information horizon

Information horizon of a public dissemination work role (Fig. 6.8) is rather manifold. The constituent factors, which affect the source selection and use, are the perceived level of adequate authority, and the topicality of the information meant for a distinct purpose of making an archaeological subject intelligible [O, P, V, K, L]. The authority question affects the dissemination process especially through a requirement not to disseminate anything consciously untrue. Even though the experimental and learning by doing -methods have penetrated the popular dissemination of archaeological information [L], the basic assumption is that the public has to be protected from false interpretations and contradictory information [O, P, V, K, L].

The starting point is typically an idea of an archaeological subject, which is considered to be deserving to become communicated. The most important sources of information tend to be the own previous experience on the subject matter, a relatively closed set of authoritative personal expert contacts and the related physical archaeological objects. Literature is being used, but the criteria of inclusion tend to be highly selective. Typically, the used sources consist of already known literary references and relatively established general literature discussing the subject matter [O, P, V, K, L].

6.5 Academic research

6.5.1 Work role

Academic research is used here to refer to a role, which comprises various types of scholarly research duties. Practically all of the informants who were involved in academic research had a primary or a secondary affiliation to an academic institution. Besides the universities, to a lesser extent, academic research is also conducted at museums and national heritage boards. The informants did, however, note that

these institutions do generally lack the resources to support permanently employed staff for the primary purpose of conducting basic academic research [A, C, F, I, J, K, L, M, O, P, Q, R, V, W].

The academic research work role excludes consciously the field research. In practise, the field projects are pertained to academic research in many cases, but not necessarily so. Considering the work role and the processes, it becomes clear that despite the strength of the connections, the activities are feasible to peruse separately. Here the designation of academic research refers to the phases of a research project, which aim to produce, summarise and elaborate knowledge on the basis of primary and secondary material obtained in field projects and literature studies.

All of the informants, who conducted academic research, were graduated in archaeology. A large proportion of the researchers were pursuing their doctoral studies either full time or part time. With the exception of one informant, all of the doctors who were interviewed, were primary university affiliates. Scholarly research in archaeology expects a good command of the archaeological intellect and practical research methods. Inquisitiveness and perseverance were indicated as adjunct important qualities of a researcher.

6.5.2 Work process

Scholarly research is an iterative process in archaeology. Informants found it relatively difficult to delineate the actual research process in distinct phases or to account accurately for their own past work processes. A typical process seems to be made up of cycles of identifying an issue of interest, seeking explanatory material, analysing and reasoning, and finally formulating and adapting the essential outcome to the context of the currently on-going project.

An initial impetus for a research project may spring from diverse sources. Typically, the incentive is something, which is encountered during a field project, in the context of another research or work project, or suggested by a colleague or a tutor. Often the starting point is a relative vague one and its emergence is more or less accidental [B, C, E, G, H, M, N, S, T, U, X]. The research proceeds by seeking of background information and establishing the context of the project. Thereafter the cycles are iterated until, most often external, reasons necessitate the conclusion of the project. Reasons for the conclusion may be the ending of financing, a deadline of submission for a publication, or reaching a level of the formal requirements to submit a thesis. Simultaneously with the cyclical process of applying oneself to the subject of the research, the writing process is initiated. A research effort typically ends with a publication of a book, an article, opening of an exhibition or giving a lecture.

The work process in academic research is illustrated in the use case diagram (Fig.) 6.9 and a root definition (Table) 6.8.

6.5.3 Interactions with information

A number of general models of information behaviour, which relate to the scholarly research in the humanities and social sciences, have been discussed in the literature (ref. Chapter 7). The suggested general models are applicable to the discussion of the domain of the archaeological academic research. From the point of view of the present study, the fundamental distinctive characteristic of the interactions with

Researcher

Customers	Scholarly community (society)
Actors	Me
Transformation	Reaching new knowledge and understanding of the specific aspects of past human activity and consequently publishing the results for the scholarly community.
Weltanschauung	It is important to understand history and past human activity.
Owners	All of us; (Me)
Environment	Academic institution; society
It is my task to find out more about history and the human past and to inform the scholarly community and, consequently, everyone of my findings. Understanding the past is important for diverse reasons. It is interesting for its own sake, it is part of our own culture and what we are. Historical consciousness does also give keys and perspective to understand the present and future societies. The past is property of all of us, but I am standing in a special position as a gatekeeper or a guide to the information. I am conducting my research as a part of my scholarly community, but also as a part of the entire human society.	

Table 6.8: CATWOE-analysis of the academic research

archaeological information assets do relate to the explicit and implicit intentions regarding the archaeological material. The two disparate viewpoints are to 1) perceive the material as the primary object of interest or as 2) an information source to reach another objectives. The first standpoint was followed more explicitly during the period, which spans from the eighteenth to the early twentieth century, when a cultural chronological standpoint held a predominant scholarly position [777, 181-198]. The more recent archaeological debate has tended to emphasise the understanding of past activity as the definite goal of archaeological research (second viewpoint, see above). This tendency is readily discernible in the material gathered for the present study. Despite that the eventual goal settings of the research as a whole are not pre-emptively related to the material itself, the importance of studying artefacts and sites as such is acknowledged widely. Meticulous studies of the materials are perceived as the primary means to provide basic material for the advanced interpretations.

From the societal point of view, the eventual objective of all academic research is to make new knowledge available. Therefore the disseminatory activity of publishing new findings is essential for the functioning of the research 'system'. Embeddedness of the publication effort is well illustrated in section of interviews, which concerned the "information product" case example (theme 4, ref. Section 4.5). The difficulties of wording out the information behaviour and source use during the process of writing an academic article or a book were distinctive in all cases where the informants had chosen an 'information product' (a 'unit of information' e.g. an article, a book, an exhibition etc the informants had created themselves or actively contributed to its realisation, ref. theme 4 in Section 4.5), which related directly to their own research work.

Find out information about an archaeological object (Fig. 6.9): The primary research oriented interaction with the archaeological material relates to the task of

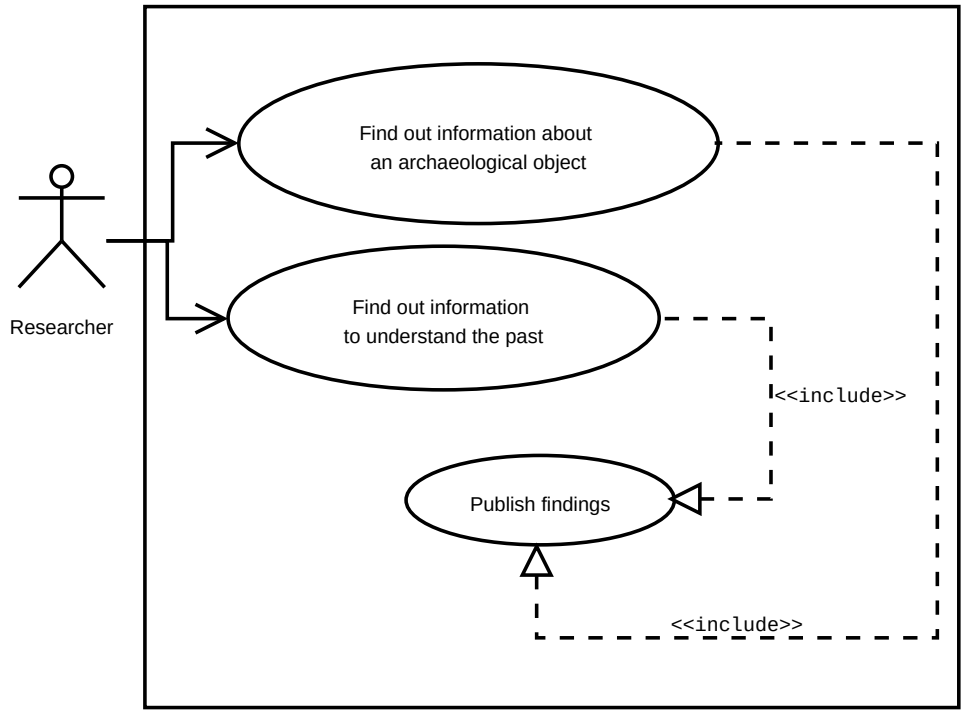


Figure 6.9: Use case diagram of academic research work role

extracting more information about it. The interaction comprises both artefact and site analysis. From a plain information process point of view, an archaeological site may be plausibly viewed as a compound archaeological object consisting of a large number of sub-objects.

The interaction with archaeological material may be scrutinised in multiple levels. The process of extracting information involves *comprehension* (e.g. observation, facet A.a) and *use* (interpretation of the analysis, facet B.a). Besides discussing the exploratory work as a process of information discovery, the interview results suggest the plausibility of an approach to perceive the process as modification and reorganisation of preexisting information. Even though the archaeological data is primarily functioning as data, it attains informational functions during the iterations of the research process (A.b, B.b).

Archaeologists analyse their data (A.b, B.b) using a wide selection of techniques and methods from the humanities to the social and natural sciences. The basic observation of visual characteristics, such as the form and colour, and quantities, like distribution and measures, may be complemented with material studies. Comprehensive chemical and physical analyses are, however, relatively rare due to their costs. The most typical method of artefact analysis is based on comparisons with the earlier findings. The analyses attempt to grasp the knowledge potential of all relevant available materials (A.c, B.c). The relevance typically springs either from the representativeness of the finds in their context of discovery, or from their unusuality, which indicate either a trend or an exception (A.d, B.d).

A. Comprehend

a. Information behaviour: *comprehend*, Method: *observe,* Mode: *recognition*

b. Objects interacted with: Level: *information (*with *meta-information*), Medium: *physical object*, Quantity: *(typically) one object*

c. Common dimensions of information: Information object: *whole*, Systematicity: systematic, Degree: *exhaustive*

d. Interaction criteria: *(knowledge) potential, representativeness or unusuality,* Obstacles: *training, resources, access, information overflow*

A. Use

a. Information behaviour: *use*, Method: *interpret*, Mode: *contextualisation*

b. Objects interacted with: Level: *information* (with *meta-information*), Medium: *physical object*, Quantity: *one object, set of objects or database of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *(knowledge) potential, representativeness or unusuality,* Obstacles: *training, appropriateness, lack of contextual information*

Find out information to understand the past (Fig. 6.9): Understanding past human activity, i.e. the principal concern of archaeology (ref. Section 5.1), may be considered essentially as a form of applied research, which builds on the basic, technical studies of the material remains of human activity. The applied research and the basic studies do, however, coincide in the practise of archaeological work. The primary information behaviour, which is related to the second level of archaeological research is that of *using* (A.a) the results from basic empirical research on archaeological sites and material to *create* (B.a) elaborate information on past human activity. The use case comprises also a limited information creation through inductive, deductive and interpretative methods, although, as will be observed, the primary location of the archaeological information creation is in publishing a set of acceptable arguments that supports a viewpoint. It is important to note that the *creation* interaction, which is situated within the use case and represents the process of reasoning, differs from the one discussed in the context of publishing (ref. next use case). The information creation discussed here, may be described as a creation of potential information, which is situated in a context of an individual until the information becomes disseminated.

The fundamental problem of archaeological research is to understand the relation of the archaeological material and the human activity. Archaeological material is a result of past natural and human processes. This connection makes it conceivable to assume that it is possible to derive information on past human life and activities by examining the archaeological material. The interference is not, however, direct nor unequivocal, which makes the eventual interpretations conditional. Similarly, the corpus of objects examined, is at its best a random sample of the original deposits, because not all of the primal objects were deposited in the first place, preserved to the present or retrieved and published by the excavating or surveying archaeologists, in spite of the theoretical requirement of exhaustivity of the field research (A.b, A.c, B,b, B.c, A.d, B.d).

A. Use

a. Information behaviour: *use*, Method: *interpret*, Mode: *contextualisation*

b. Objects interacted with: Level: *information* (with *meta-information*), Medium: *physical object (multiple)*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *authority, representativeness or unusuality,* Obstacles: *training, appropriateness, lack of contextual information*

B. Create

a. Information behaviour: *create*, Method: *cognis*e, Mode: *induction, deduction, interpretation*

b. Objects interacted with: Level: *information* (with *meta-information*), Medium: *physical object (multiple)*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *plausibility,* Obstacles: *training, lack of contextual information*

Publish findings (Fig. 6.9): The publication of the findings is a combined effort of information *creation* (A.a) through careful argumentation, and of *dissemination* (B.a) through making the findings available for the scholarly community. The prevalent form of publishing is a printed book or a journal. Books hold a position as a good and consistent publication form for a comprehensive treatment of larger entities of information such as entire research projects, sites and issues. Journal articles were perceived by the interviewees as a media for publishing brief reports on relatively small scale subjects. According to the interviewees, at the time of the interviews electronic sources and repositories were used rather little, even though it seemed that they were becoming more popular (A.b, B.b).

Publishing new findings is the beginning of the social life of the information and thus it is an act of information creation. Information becomes manifest and intelligible first in the process of disseminating the individual ideas as a coherent structure. Besides the explicit act of 'making available', the publishing serves an important social purpose within the academic and semi-academic community of archaeologists. The reputation of an individual depends largely on the acceptance and the perceived importance of submitted reports and publications. Therefore it is necessary to understand the publication effort also as a form of a social activity, which aims to promote and maintain the status of the publisher within the community. The dynamics of this social control acts as a filter, which maintains certain standards in the intra-social communication. Simultaneously the requirement of *acceptance* does limit the extent of disseminated information (A.c, B.c). Utterances and known uncertainties are typically removed or unemphasised in the published versions. The included probabilities and possibilities, which accompany the principal findings, tend to become expressed in a form, which underlines their simultaneous plausibility and uncertainty (A.d, B.d).

A. Create

a. Information behaviour: *create*, Method: *argument*, Mode: *contextualisation*

b. Objects interacted with: Level: *meta-information*, Medium: *physical object (multiple)*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *authority, representativeness or unusuality,* Obstacles: *training, appropriateness, lack of contextual information*

B. Disseminate

a. Information behaviour: *disseminate*, Method: *publish*, Mode: *(typically) write, (also) speak and draw*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple* (typically text), Quantity: *one object – set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *authority,* Obstacles: *lack of information, (training)*

6.5.4 Information horizon

Information source use in the academic archaeological research is characterised by the use of traditional information infrastructures (ref. Fig. 6.10). The source material shows, however, considerable heterogeneity. The most important source for archaeological research is the physical archaeological material, which includes sites, artefacts and samples. Equally important materials are the compiled investigation reports, photographs, drawings and the comparable documentation, which describes the work process, archaeological objects and their contexts. All informants shared a view that the original material is irreplaceable in the academic archaeological research. Surrogates, whether being photographs, drawings or eventually graphical multidimensional models, are used only if the originals are inaccessible. Typical reasons of inaccessibility were perceived to be the distance and the cost of travelling to the location of the objects.

Archaeologists tend to rely on secondary sources when it comes to the material on the topics concerning related disciplines. Only a minority of the informants reported that they use primary textual sources while studying historical period topics. Many of the interviewees reported that they rely on the secondary accounts written by historians, because of the lack of special expertise to work with the original documents [D, G, P, S, V, W, Z]. Unlike the textual documents, the historical maps were utilised rather frequently [e.g. A, D, F, N]. The general tendency of using both historical and modern maps depends largely on the research topic. There seems to exist a rather fundamental divide between a 'spatial' and 'aspatial' archaeology. The first is characterised by field work, landscape and broader geographical and societal approaches, while an orientation towards cultural, functional and artefact analytical themes seem to be less concerned with the spatiality.

Most of the academic literature is published in printed journals and monographs. The high variety of research topics and themes keeps the circulation of many of the specialist publications rather small. Significant international journals are published on various topics, but their status tends to be considerably lower than the renommee of their counterparts in the sciences.

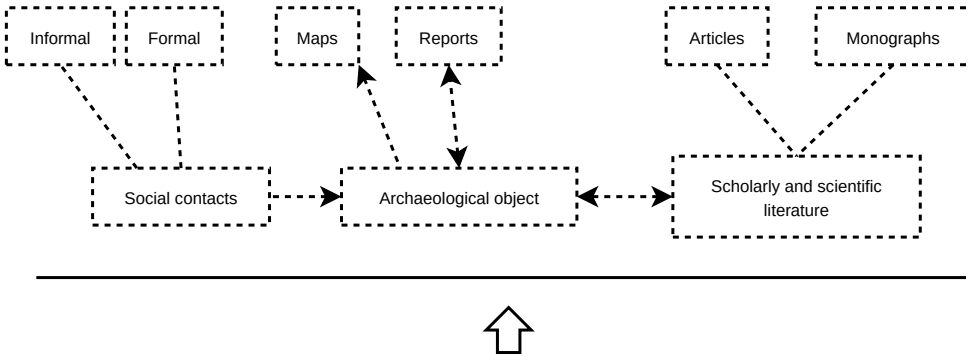


Figure 6.10: Information horizon of the academic research work role

Social contacts are essential in the archaeological research. Informants tended to prefer informal communication over the formal channels. The importance of the scientific conferences and symposia was acknowledged in providing a formal framework for informal communication. Social networks seem to be organised primarily around the existing strong bonds between the professionals. *Ad hoc* contacts outside the preexisting circle of colleagues are relatively scarce. Advice is sought from outside only if the expected benefits are considerable or if there seems to be no other alternative. The role of the popular media as an information source for the academic research, was stated to be minimal. Almost all did, however, express semi-active to active attention to some type of popular media. Most informants were active newspaper readers, although practically everyone expressed strong doubts on the validity of the published reports, especially when they concern archaeological matters. Television was among the least popular choices of media.

Typical starting points for the primary and secondary research material and literature were earlier known literature and especially the lists of references. Another important source of references were the colleagues and the earlier known archaeological material.

6.6 Academic teaching

6.6.1 Work role

The role of academic teaching refers to the full-time and part-time university educators. Archaeology departments employ relatively few people on a permanent basis as full-time or part-time teachers. Most of the teachers holding a permanent position have completed their doctoral degree. The lectures and courses held by permanent staff members are complemented by part-time lecturers who are employed outside the university in museums and other heritage institutions [O, C], or are graduate students at the department. The doctoral students have rather typically some amount of teaching incorporated in their contract of employment. In Finland, there is more variation, because most of the graduate students in archaeology are financed either by research projects, by individual relatively short period grants from private funds and foundations, or are conducting their research on their spare time [B, G, H, T].

The academic teaching role may involve a great variety of tasks, which are rele-

vant to the archaeology education and its planning. Depending on the position of the teacher and the division of work at an individual department, the duties may include giving lectures, having practical field and classroom exercises, holding examinations, reading essays, planning study programmes and supervising students. Part-time personnel concentrate mostly in giving courses [H, M, S, Z].

6.6.2 Work process

The work process of academic teaching work role consists of various tasks related to the education and training of the archaeology professionals. Curriculum management and planning is teamwork shared by the entire teaching staff of the department. Individual courses and their precise contents are typically left to the discretion of the individual lecturers, although the old course contents are often made available for the new lecturers to ensure some degree of continuity [Z].

In spite of the diverse tasks, the full-time teaching follows relatively closely a yearly schedule [M]. The informants concentrated mostly on teaching and preparatory work during the periods when courses were under way [H, M, S, Z]. In introductory studies, the wider framework of the courses tends to be relatively static. Regular updates are needed to complement the earlier lectures with new information and viewpoints. Advanced courses change more frequently, because they typically deal with more specific questions. Completely new courses are prepared rather rarely. This is done mostly when the curriculum is subjected to a major revision [M, Z, S]. Apart from preparing lectures, demonstrations and exercises, the teaching duties consist also of marking examinations and reading essays [H, M, S, Z] and, most importantly, giving feedback and personal supervision [H, S]. The proportion of supervision, discussions and feedback increases when the students begin to study for their master's and doctoral degrees. Undergraduate education tends to emphasise less the reciprocity in pedagogy, partly due to larger group sizes and partly, because of the more informative than discursive focus of the studies [H, S, Z]. In Sweden the situation was described to be somewhat different in the universities than in the 'university colleges' (Swed. *högskola*). The respondents indicated that the universities have usually higher intake and larger groups of students attending the courses [Z]. Most of the undergraduate courses tend to be in form of lectures at the universities, while at the university colleges, the smaller group size allows more interaction with the students.

Pre and post semester periods were reserved by most informants to the more comprehensive updating of the courses, preparation of new contents, revisions and general planning activities. All interviewees also indicated that they attempted to reserve part of these periods for research and other professional activities [H, M, S, Z]. Especially in full-time positions, these periods tended to be rather short and were frequently interrupted by unwanted extraordinary duties. Part-time teachers were able to arrange their annual schedule more freely. [C, T, O, T, U].

Root definitions are given from two viewpoints (student and teacher, ref. Table 6.9). The analysis omits the perspective of those students, who study archaeology as a minor subject. They might be expected to have objectives and expectations, which are out of the scope of the present study of (emphatically) archaeological information work.

Teacher

Customers	Student
Actors	Me
Transformation	Getting an archaeology student to become concerned and informed of the constituent aspects of the archaeological knowledge so that she will be able to work as a professional archaeologist.
Weltanschauung	It is important to ensure that the students learn the essential content of my teaching and obtain proficiency in the science and craft of archaeology.
Owners	The community of archaeologists; University; Me
Environment	University
I am employed at the university to teach new archaeology students, that is, forthcoming archaeology professionals, my future colleagues and successors in the science, art and craft of the archaeological profession. My duty is to make the students to learn the essentials so that they will be able to perform well during their future career. I am responsible for my job to myself, to my colleagues at the department and to my university. In a broader framework, I am responsible for the whole community of archaeologists that the future archaeology professionals share the essence of our profession.	

Student

Customers	Me
Actors	Teacher (supervisor)
Transformation	I am learning the skills required and needed to be able to work as a professional archaeologist.
Weltanschauung	The responsibility of the teachers is to provide me with high quality education. My own duty is to try to learn the skills and acquire the knowledge so well that I am able to carry out my future job.
Owners	Teacher; (University)
Environment	University
I am here at the archaeology department to study and to learn to become a professional archaeologist. I have to learn all the necessary skills and acquire the required knowledge to be able to perform adequately in my job. The proficiency of my teacher and supervisor, and my own diligence help me to learn everything I need to know.	

Table 6.9: CATWOE-analysis of academic teaching

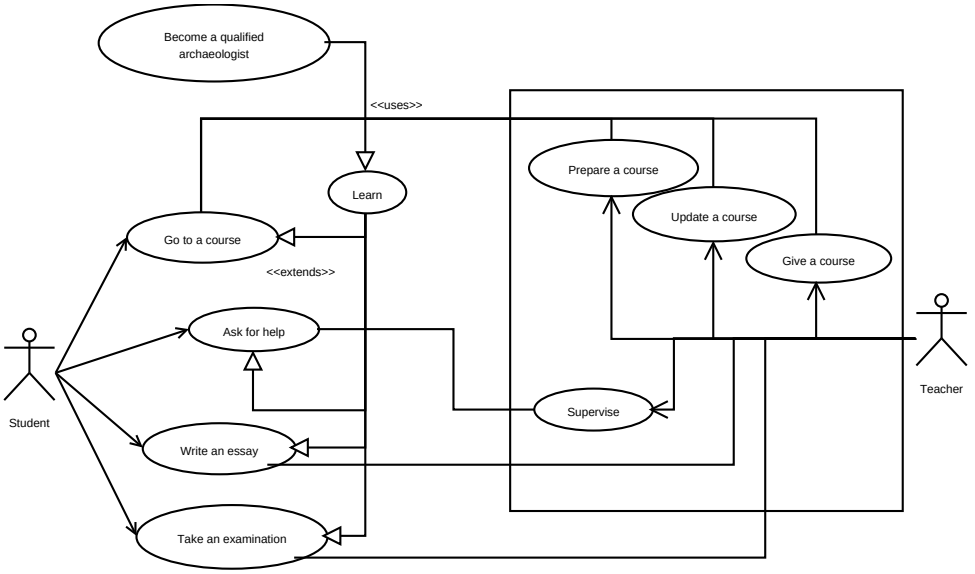


Figure 6.11: Use case diagram of academic teaching role

6.6.3 Interactions with information

The constituent information interactions of the academic teaching work role are interlocked with awareness keeping, and evaluation and processing of information. The scope of the interactions tends to be broader than in the other work roles.

Academic teaching serves an intermediary function. Because the frame of reference for the present study is the management of an information process, the constituent transformation appears as an act of a focussed reorganisation. Basically the process comprises information behaviours of access, comprehension, evaluation, reorganisation and dissemination. The most critical phase, considering the task performance, is the reorganisation of the existing scientific and scholarly information in a form, which could be expected to enable effective communication of the information to the students.

Update a course (Fig. 6.11): Updating an ongoing course is based on constant *accessing* and *scanning* of the new relevant literature (A.a). Some teachers update the whole course at once using the gathered materials, while others tend to update individual lectures, demonstrations and exercises only immediately before they are held. Most of the teachers were of the opinion that there are very few practical possibilities to search actively for new information. Most of the new material accumulates through 'active encountering'. Teachers talk with each other, try to read regularly some relevant journals and keep aware of the new literature (A.b). One respondent told about the limited possibilities to read new literature and stated that in practise, there is time to check only those new books, which are bought to the departmental library (A.c, B.c). Besides the new literature, the course updates and *modifications* are based on the remarks added to the lecture notes during the previous runs of the course. The remarks may refer to details such as the need to check some subtleties or to restructure some part of the story (B.a).

The most significant criteria for updating the courses are the appearance of new *important* and *authoritative* knowledge, importance and topicality of the new and

preexisting information and the functioning of the earlier material in the practise of education (A.d, B.d). The primary obstacles for updating include the impossibility to cover all the available data during a relatively short course, and to process all relevant information. Appropriateness of the individual topics in a context and the students' earlier level of knowledge do have an additional effect on the selection (A.d, B.d).

A. Access

a. Information behaviour: *access*, Method: *scanning*, Mode: *recognition*

b. Objects interacted with: Level: *meta-information*, Medium: *literature, personal communication*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *authority, topic,* Obstacles: *appropriateness, time, resources, access, information overflow*

B. Modification

a. Information behaviour: *modify*, Method: *reproduce (reorganise),* Mode: *update, replace*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple (mostly text and visual material)*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *exhaustive*, Degree: *selective*

d. Interaction criteria: *authority, importance, topic, functioning*, Obstacles: *training (students), time, resources, access, information overflow, appropriateness*

Prepare a course (Fig. 6.11): Completely new courses are introduced rather seldom in educational programmes. The curricula do evolve rather than change drastically. The slow pace of evolution characterises especially the basic studies where the subjects are on such a fundamental level that the change is bound to be slow. The fundamental nature of the basic studies information is underlined by the fact that the education starts from the absolute beginning, because archaeology is not a regular subject in comprehensive schools and grammar schools in the Nordic countries.

When the preparation of a course starts from the beginning, its general frames are typically drafted together with the entire teaching staff of the department. The appointed teacher of the new course often consults subject experts if not being one herself (A.a, B.a). Information seeking starts from a generic monograph on the subject closest to the topic and continues iteratively through lists of references and formal searches to complementary literature until the perceived information needs are satisfied or the available time is out (A.b-c, B.b-c). The interaction is steered by the criteria of topicality and authority and constrained by appropriateness and the availability of resources (A.d, B.d).

A. Access

a. Information behaviour: *access*, Method: *searching*, Mode: *specification*

b. Objects interacted with: Level: *meta-information*, Medium: *literature, personal communication*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *authority, topic,* Obstacles: *appropriateness, time, resources, access, information overflow*

B. Organise

a. Information behaviour: *organise*, Method: *rewrite, restructure*, Mode: *summarisation, (simplification)*

b. Objects interacted with: Level: *meta-information*, Medium: *literature, visual material*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *exhaustive*, Degree: *selective*

d. Interaction criteria: *authority, topic,* Obstacles: *training, appropriateness, time, information overflow*

Give a course (Fig. 6.11): Giving a course is a rather straightforward act of information *dissemination*. The prevalent educational methods are usually rather traditional and consist of lecturing and organising seminars. Practical exercises relate mostly to the field research methods. The somewhat smaller group sizes in the new Swedish university colleges have made possible a limited adoption of more interactive educational methods. On the advanced level of studies the amount of individual work and discussion oriented seminars increase in the favour of formal lectures and exercises (a).

Informants emphasised the importance of visualisations in lectures and exercises. Slides on the actual archaeological artefacts and landscapes, maps and diagrammatic drawings provide important visual insights in the subject matter and promote understanding of the discussed archaeological phenomena. The notion of scale is also best mediated in visual presentations of both the individual objects and sites (b). One of the informants described the use of documentaries on diverse levels to visualise archaeological objects, sites and landscapes, to provide import for later processing and to offer visual stimuli for intellectual contextualisation of the subject [H, M, Z].

In course level interactions the most important informational criteria are the *topicality* and *authority* of the dissemination of information. The most critical obstacles consist of the level of earlier *training* of the students, of the huge *amount of existent information* and of the practical limits of available *time* (d). The choice of information is systematic and selective according to the discretion of the teacher (c).

a. Information behaviour: *disseminate*, Method: *speak*, *(show, discuss)*, Mode: *instruction*

b. Objects interacted with: Level: *information* and *meta-information*, Medium: *written text, speech, images*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *systematic*, Degree: *selective*

d. Interaction criteria: *topic, authority,* Obstacles: *training, information overflow, time*

Supervise (Fig. 6.11): Supervision is an interaction, which is rather difficult to classify in an unambiguous manner as a compound of information behaviours. Primary functions of the supervision are evaluation, organisation and limited dissemination of the information using bi-directional communication. Supervision is the most typical interaction with advanced under-graduate and graduate students. The main part of their study effort is concentrated on writing final essays or a thesis, which completes their studies for a degree. Especially with graduate students, the interaction is notably bi-directional. Teachers provide formal and practical advice, and evaluate the on-going work. The students on the other hand are experts of the subject of their own research [H, S].

The *evaluation* interaction involves cross-checking against formal guidelines of academic essays and theses (A.a, A.b). Besides the formal criteria, an important aspect of evaluation is the *rationality* of the knowledge claims presented in the submitted paper (A.d). Evaluation is in principle a systematic and exhaustive process (A.c). The practical conduct of evaluation involves *selectivity* and *randomness* due to various constraints, including *time* and the subject knowledge (i.e. *training*) of the evaluator. The most topical criteria of interaction is the perceived *authority* of the submitted thesis, even though in a factual sense, the aspects of *accuracy*, *importance* and *topicality* are of an equal importance (A.d).

The *dissemination* interaction related to the supervision use case is typically done in the form of informal discussions between the supervisor and the supervised (B.a, B.b). Another typical medium of communicating the information is correspondence by mail or by email (B.b). Larger part of the disseminated information is meta-information on available information sources or information on the topics related to the theme, which is currently under discussion. Dissemination of information during supervision is seldom a systematic or an exhaustive process. Information tends to be highly contextual, tacit, sporadic and haphazard (B.c). Information is characterised by expected and perceived *topicality* and *authority*, while the most considerable obstacle to reach the disseminative goals is often the lack of *appropriateness* of the information in the precise context [H, S] (B.d).

A. Evaluation

a. Information behaviour: *evaluate*, Method: *cross-checking (against formal guidelines, context i.e. earlier research)*, Mode: *comparison*

b. Objects interacted with: Level: *meta-information*, Medium: *(typically, mostly) text*, Quantity: *one object (thesis)*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *authority, (accuracy, importance, topic)*, Obstacles: *training, appropriateness, (time)*

B. Dissemination

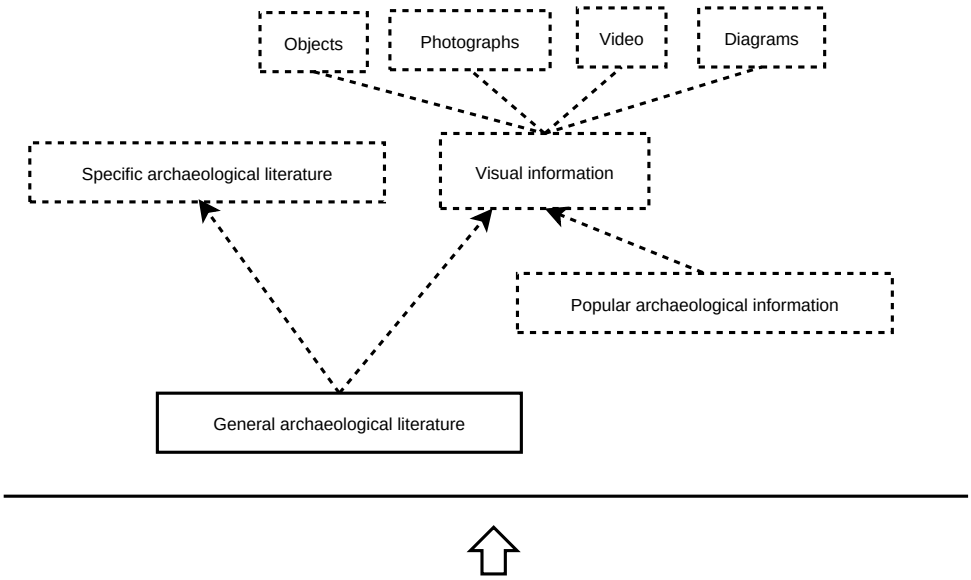


Figure 6.12: Information horizon of the academic teaching work role

a. Information behaviour: *disseminate*, Method: *speaking (correspondence)*, Mode: *informative*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *topic, authority,* Obstacles: *appropriateness*

6.6.4 Information horizon

Information horizon in the academic teaching work role (Fig. 6.12) tends to be broad, but relatively shallow in comparison to the research oriented work roles. The primary material for academic teaching is the established archaeological literature, which is complemented with diverse actual matters drawn from the current research. The use of literature differs in the basic courses from the advanced level instruction. The information used in the basic courses is typically derived from the general works and it tends to evolve rather slowly. In the advanced undergraduate and graduate courses, the amount of specific and controversial material increases simultaneously with the specialisation of the participants' scholarly interests and knowledge.

Even though the research literature is acknowledged to be the most important information source, the academic teaching relates most positively of all of the work roles to the popular media, even though the popular sources are used more typically for the purposes of visualisation than as a source of information [M, Z]. The role of social information seeking is important also for the educators, although it seems to be somewhat less important than in the other work roles.

6.7 Cultural heritage administration

6.7.1 Work Role

The role of cultural heritage administration is used here to designate the archaeological work procedures, which relate to the work of the administrative staff of the cultural heritage administration bodies, policy makers and managers of investigation and maintenance projects. The duties comprise indirect customer service, where the typical customers are private and public exploiters of land and landowners. Apart from the reactive work, the duties include proactive informing, definition of guidelines and good practises, policy making, implementation of policies, surveillance and maintenance of the cultural heritage sites.

The national heritage bodies only seldom launch research surveys or excavations of purely academic interest. In principle, all surveys and rescue operations are preceding land exploits, or serve as providing a basis for the future infrastructural planning or maintenance of the already known heritage sites. Considering the scope of the present research, the situation is in practise somewhat more complicated. Both in Sweden and Finland, the cultural heritage administrative bodies, the National Board of Antiquities (Finland) and the National Heritage Board (Sweden) have assumed a dual-role as administrative bodies and research institutions. Part of the cultural heritage management work has been delegated to a number of related national institutions and provincial museums.

In Sweden, the Museum of National Antiquities is the responsible authority for the national archaeological collections. National maritime museums of Sweden assume a similar role concerning the maritime heritage. Unlike in land archaeology, where the archaeological excavations are primarily carried out by the investigations department of the National Heritage Board, maritime museums are responsible also for the maritime archaeology.

In Finland, the National Board of Antiquities has been responsible for both land and maritime archaeological operations and collections from the beginning of the year 2004. Land archaeology is divided according to historical periods between the Department of Archaeology (prehistorical archaeology) and the Department of Monuments and Sites (historical archaeology). In Sweden, the land archaeology is located in the Archaeological Investigations Department of the National Heritage Board, which has five regional offices around the country [A, C, F, J, O, P, Q, R, V, W]. Plans to transfer the investigations division to a separate public utility were announced in 2005 [579][626]. In spite of the somewhat diverging organisational structures, the basic work processes of the individual archaeologists differ relatively little between the two countries.

Most of the archaeological heritage administrators are educated as archaeologists. Usually they also have previous field work experience. Besides archaeologists, the heritage administration bodies employ e.g. architects, conservators and historians. The archaeological education of the administrators is occasionally supplemented with a more or less informal complementary education in project management and e.g. economics. Experience, for instance in cultural environment studies, museology, geographic information systems and heritage policy were indicated to be useful in the administrative duties. Job descriptions and titles vary slightly from one institution to another. In Finland, the administrators work often under the title of "researcher". Other typical designations include antiquarian, intendant, project manager and project researcher [A, C, D, F, I, J, O, P, Q, V, W].

6.7.2 Work process

Cultural heritage administrators do not have a uniform work process. The work comprise writing reports and statements about land use related matters, working in steering groups, coordination of archaeological operations, writing research permissions, budgeting, personal administration, supervision and field inspections. According to the interviews, the management of cultural heritage seems to be a largely reactive enterprise [C, W]. Policy making is acknowledged to be an important aspect of an efficient management of heritage resources, but in practise a large part of the everyday routine consists of reacting to private and community land use projects. Decisions and actions are based on existing legislation and administrative guidelines, which are being actively formulated, and simultaneously adapted to the contemporary demands and to an existing consensus on the estimation and understanding of the concept 'cultural heritage' [A, C, J, P, W].

The typical workflow begins with a request for an opinion on a land use project. In the best case, the opinion is sought during the early stages of planning, but frequently the planning is well under way, or at worst, finished before the first contact [C]. The opinion of the administrative body is based on the existing data on the heritage sites in the affected locality. Currently only a small portion of the data has been digitised and inserted into a geographic information system or cultural heritage management system. The background work for an administrative opinion presumes almost without exception a task of consulting printed archive materials, including earlier research reports and occasionally paying a visit to the actual site. Depending on the initial results, the responsible administrator formulates an opinion together with his superior. In the opinion, the administrator may request further investigations or allow the project to proceed under the surveillance of an archaeological supervisor. If anything is unlikely to be found, the opinion may also state that the project may proceed, but if anything should be found, the contractor is expected to report of the findings and halt the work until an archaeologist has visited and evaluated the site. The fast pace of landuse necessitates a continuous effort of assessing and evaluating the cultural heritage assets. It is important to be able to make fast, educated decisions about befitting actions. The inherent complication of the decision making process is that even though some rather well established guidelines do exist for individual decisions, the individual cases are highly context dependent.

The administrative work comprises also inspections and supervisory work of ongoing excavations and research projects. On a field trip an administrator visits a site, inspects its state of conservation and makes an assessment on the necessary actions [W, F]. In field projects, the role of an administrator consists of budgeting, personnel management and the management and supervision of the project, but excludes the practical field work [C]. The operations carried out in Finland and Sweden resemble each other, although in Sweden the field director tends to have slightly more responsibility on the management of the project besides the field work.

The bulk of the policy work, which relates to the cultural heritage administration, is done in work groups and steering committees [C, W] of the national bodies. The strength and relative unambiguity of the antiquities legislation in Finland and Sweden provide the cultural heritage administrators with good possibilities to interfere and force archaeological investigations and protection of the monuments. The only problematic exception is underwater heritage. The antiquities acts collide with the maritime legislation in both countries. According to the antiquities

Administrator

Customers	Society; Constructors; (cultural heritage)
Actors	Me; Constructors; Policy makers; Academia
Transformation	My duty is to conserve and protect important cultural heritage assets for the contemporary society and for the future generations. The work is constant balancing between the community development and the preservation. Both the parties have to compromise and the final outcome is always a consensus of divergent priorities.
Weltanschauung	It is important to preserve cultural heritage assets for the society. They are an important part of our culture and society, and as objects of the past they are essentially irreplaceable. However, prioritising and policy decisions has to be done, because the community development and construction works are also of importance.
Owners	Society; Bodies responsible for the heritage preservation and administration; (landowners, communities; state)
Environment	National state (divided into administrative regions)
I am working as a cultural heritage administrator to preserve and administer our common cultural heritage. It is important to save and conserve unique sites, monuments, artefacts and landscapes for the future. Yet it is also important to balance between the preservation and the communal and individual construction and development needs. I believe that it is possible through a thorough understanding of what is essential and what is less important within both the spheres.	

Table 6.10: CATWOE-analysis of cultural heritage administration (Administrator)

legislation, the cultural heritage is the property of the state, whereas the maritime legislation underlines the rights of the discoverer and rescuer [A, C, P, W]. Because of the legislative situation, there is a number of on-going lawsuits related to the underwater and maritime heritage in both of the countries (ref. also Section 5.4.2).

The related root definitions include the viewpoints of the cultural heritage administrators ('administrator') and of the constructing enterprises, infrastructural development agents and similar actors designated as 'developers'. Both the use case representation and the root definitions are relatively generic because of the variety of the actual duties related to the work role. Especially the Weltanschauung shows significant variation between the individual actors. Some administrators are more sympathetic to the constructors' efforts than the others. Similarly part of the developers have clearly positive attitudes toward archaeology, archaeologists and heritage management, while others maintain nearly hostile opinions [C, P, W].

6.7.3 Interactions with information

Cultural heritage administration involves a wide range of interactions, which attempt to relate the archaeological knowledge and valuations to the societal needs for community and infrastructural development. The work procedures could be broadly categorised to be reactive and proactive.

Developer

Customers	Me
Actors	Cultural heritage administrator
Transformation	Cultural heritage administrators tell us by sending an opinion whether our project may proceed, do we need to pay for archaeological investigations or do they block the project altogether.
Weltanschauung	Basically it is nice to preserve cultural heritage and I enjoy visiting historical sites. The cultural heritage administration people are working in a professional manner, but still I think that they give their opinions in a pretty random way. In one project we had no problems with large scale works near a historical site, but in another we were prohibited to do some minor modifications with something I perceive as relatively uninteresting.
Owners	Me; (partly also the heritage people as they interfere with my project)
Environment	Construction site
My duty is to construct buildings, roads, railway lines and other infrastructures for us to use. They are important as we need houses, fresh water, electricity and communication lines to live and prosper. Cultural heritage sites may be found everywhere. I know that important things have to be protected and that is why, I have to cooperate with the cultural heritage people. Normally I ask them for their opinion and then they tell me what I can do and what I can't do. They can also make some suggestions to modify the project plans. If our cooperation works well, both the sides should be happy and the projects may proceed according to schedule.	

Table 6.11: CATWOE analysis of cultural heritage administration (Developer)

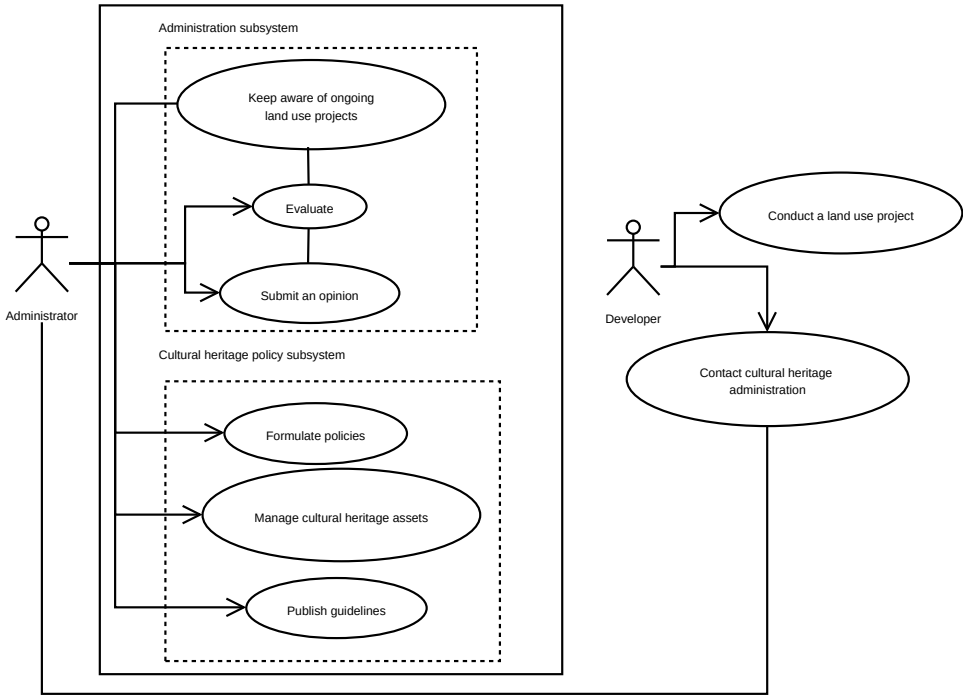


Figure 6.13: Use case diagram of cultural heritage administration role

A considerable proportion of the information activity in the cultural heritage administration relates to the reactive work of keeping aware of the current community planning, conducting appropriate enquiries and finally submitting an opinion on the proposed project and possibly required archaeological interventions (Administration subsystem, Fig. 6.13). Most of the larger professional exploiters request for opinions by themselves in the early stages of the planning, but many of the exploits are noticed only by occasional mentions in media or by a request submitted directly before the beginning of the work in practise.

Second category of the information rich administration duties consist of proactive policy making, maintenance and development work (Cultural heritage policy subsystem, Fig. 6.13). Efforts are based either on projects or broader themes. Projects vary in length from weeks to years. The developmental themes tend to span over 2-3 years and to typically concentrate on the advancing of knowledge, practises, policies and on the general awareness of a particular field of the cultural heritage. Examples of such themes might include historical monuments of a certain period, urban archaeology or the preservation of shallow water maritime archaeological heritage.

Keep aware of ongoing landuse projects (Fig. 6.13): Keeping up awareness of the current land use exploits in national and regional scale is a difficult task. Today, most of the larger exploiters do contact antiquities authorities on their own initiative, because consultation is economically viable at the earliest stages of the planning. At this stage most of the archaeologically motivated changes to the project plans are still relatively effortless and inexpensive to do. Smaller and more occasional exploiters are seldom equally well informed, which causes problems.

The most important sources for the *access* (a) to the information about the new

developments are the spontaneous requests made by the exploiters themselves. Besides the official channels (e.g. reports or requests), information may be received through incidental channels such as informal contacts with the local authorities, individual archaeologists and the local people, or by browsing newspapers or watching television (b,c). The most important criteria for an intervention is the '*topic*' of land use in any area of probable or known archaeological interest. Typically the obstacles include both the *overflow of information* in the sense of irrelevant information and *lack of information* when it comes to relevant contacts (d).

a. Information behaviour: *access*, Method: *scanning*, Mode: *recognition*

b. Objects interacted with: Level: *meta-information*, Medium: *text, speech, audio-visual*, Quantity: *one object*

c. Common dimensions of information: Information object: *part*, Systematicity: *random*, Degree: *selective*

d. Interaction criteria: *topic*, Obstacles: *information overflow, lack of information*

Evaluate (Fig. 6.13): Evaluation concerns the process of identifying probable sites of archaeological interest within a designated area of a forthcoming exploit. The evaluations are based on existing information on the local archaeological heritage and an *analysis* of various information sources (A.a, A.b, B.b). Their purpose is to estimate the possibility of finding more sites (B.a). An evaluation is concluded by assessment of the archaeological significance of the area and subsequent instructions to conduct further research or to proceed with the exploit.

The enquiries are systematically complicated by the *lack of comprehensive information* on archaeologically interesting and important areas (A.d). The bulk of the land area both in Finland and in Sweden has been surveyed at least on a superficial level. However, the age and detail of the surveys varies considerably. Archaeological sites may have been destroyed after the survey and new ones may have come to light thereafter. Similarly the survey may have concentrated on some special group of sites such as the prehistorical ones, effectively omitting most of the historical sites and monuments of importance. Besides the content related problems, the use of existing information is often rather laborious. The archives of the antiquities authorities are the only comprehensive central repositories of information in both of the countries. Centralised information systems are currently under development, but similar to the databases of archaeological collections, they do contain only part of the existing data. Therefore, the assessment is typically preceded by checking of several different information sources, which often are physically located in separate archives and libraries (A.b, A.c).

Information seeking is, in theory, *systematic* and *exhaustive* (B.c) yet in practise it is a *selective* process guided by the seeker's earlier experiences on the probability and feasibility of various actions (A.c). Interaction is typically constrained by the lack of *time* and *relevant information*, *overflow of irrelevant and dubious information* and potentially also lack of *training* when it comes to the recognition of rare and unusual materials (A.d, B.d). Evaluation is based on authoritative and accurate accounts on the topic. Typical problems mentioned by the informants were the lack of a firm archaeological interpretation of a site or an area. A survey report, which mentions, for instance, the existence of a 'mound' is of very little use if no estimation of its

archaeological significance is given. The obstacles relate to the subsequent *appropriateness* of information, *time* limits and *problems of interpreting* various finds and accounts (B.d).

A. Access

a. Information behaviour: *access*, Method: *searching*, Mode: *specification*

b. Objects interacted with: Level: *meta-information*, Medium: *text*, *cartographic information*, *photographs*, *sketches*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *topic*, Obstacles: *time*, *information overflow*, *lack of relevant information*, *(training)*

B. Evaluate

a. Information behaviour: *evaluate*, Method: *reference studies*, Mode: *comparison*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *authority*, *accuracy*, *topic*, Obstacles: *appropriateness*, *time*, *training*

Submit an opinion (Fig. 6.13): Submitting an opinion is a rather straightforward act of *disseminating* (a) targeted (meta-)information about the archaeological importance of a site (b) to the exploiter and the archaeological authorities. The opinions should be accurate and authoritative (d) as it is as important to be able to proceed with the land use as it is to preserve the important archaeological sites. The most frequent problem in giving accurate opinions, is the lack of proper information, which leads often to a resolution of launching an investigation of the area at the expense of the exploiter (c).

a. Information behaviour: *disseminate*, Method: *correspondence*, Mode: *targeted*

b. Objects interacted with: Level: *meta-information*, Medium: *(typically, mostly) text*, Quantity: *one object*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *authority*, *accuracy*, Obstacles: *lack of information*

Formulate policies (Fig. 6.13): Policy formulation does not necessarily sound like an information interaction. It is, however, an important formal step in archaeological information process. Archaeological information is operationalised from a remnant of the past to an actor in the present. Policy formulation is considered

here as an act of *organising* a distinctly selected set of information to a formal code of conduct (a). The organisation consists of structuring existing knowledge, reflecting its value to the current valuations and perception of importance, and finally of compilation of the achieved consensus into a set of formal guidelines. The policies are formulated on the basis of the available archaeological (meta-)information (b). The information and meta-information are taken to represent an overview of the current state of archaeological priorities and knowledge (c, d).

a. Information behaviour: *organise*, Method: *structuring*, Mode: *compilation*

b. Objects interacted with: Level: *meta-information*, Medium: *text*, *multiple*, Quantity: *database of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *importance,* Obstacles: *appropriateness*

Manage cultural heritage assets (Fig. 6.13): Management interaction is used here to denote the basic objective of cultural heritage management to *preserve* cultural heritage assets (a). The one interaction is divided into two distinct, but formally closely similar preservation tasks. On the one hand, the preserved asset is the archaeological site itself. It functions as a piece of information about the past. On the other hand, the information is preserved in a form of *meta-information* (b). Both interactions contribute to the preservation of the essential cultural heritage asset in a context. Assets are preserved as a whole either physically or partly in physical and partly in meta-information level. With foreseeable practical limitations the conservation is theoretically intended to be *exhaustive* when it comes to the assets of importance (c). Obstacles to the preservation are *time* as an eroding factor, lack of *resources* and a present and increasing *overflow* of the assets i.e. information (d).

a. Information behaviour: *preserve*, Method: *management*, Mode: *maintenance*

b. Objects interacted with: Level: *meta-information* and *information*, Medium: *multiple*, Quantity: *database of objects*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *importance,* Obstacles: *time, resources, information overflow*

Publish guidelines (Fig. 6.13): Publishing of the cultural heritage management guidelines relates closely to the policy formulation as a subsequent act of *disseminating* information about the policies. Publishing is mostly done by disseminating guidebooks and instructions through the available channels (a, b). The guidelines represent consolidated knowledge (b). Most guidelines are published in books or at the website of the authority. Some guidelines are available as technical reports and brochures. The guidelines are published according to the perceived needs of the stakeholders of the various fields of the cultural heritage work, including the exploiters, owners and maintainers of the archaeological heritage sites. The guidelines are published also with the general public in mind, in order to provide information and raise awareness of the current issues in the field of cultural heritage.

The publishing effort is often restricted by the limited amount of resources available for producing and especially marketing and distributing the publications (d).

a. Information behaviour: *disseminate*, Method: *publishing*, Mode: *making available*

b. Objects interacted with: Level: *information*, *(meta-information as a pointer to the information sources on e.g. archaeological heritage management and policies)*, Medium: *multiple*, Quantity: *one object*

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic*, Degree: *exhaustive*

d. Interaction criteria: *authority, accuracy, importance, topic,* Obstacles: *resources*

6.7.4 Information horizon

Information horizon of the cultural heritage administration work role (Fig. 6.14) is theoretically broad, but tends to get heavily narrowed down by the constraints of availability and time to access information. The key information source for an administrator is the archive of investigation reports and the corresponding databases, if they are available. The role of personal contacts is equally important in the awareness keeping and information seeking processes. A considerable portion of the work is possible only because of a well-established network of authoritative contacts with the colleagues, who are working as archaeologists and in other fields, which are broadly related to the cultural heritage management.

The initial information is elaborated by using basically all accessible methods. The information seeking process usually starts on a quick search on the Internet. The seeking proceeds in archives, libraries and databases to include relevant reports, texts, photographs, and both new and historical maps. Of the literature, the archaeological monographs are typically preferred due to their comprehensiveness and easier reachability through the library catalogues. Informants remarked of the relative absence of useful reference works apart from the *Kulturhistorisk lexikon för nordisk medeltid* (Cultural historical lexicon of the Middle Ages in the Nordic Countries) and the recently terminated Nordic Archaeological Abstracts (NAA). The NAA case is of a special interest, because it was frequently mentioned as an important information source by many field archaeologists and administrators both in Sweden and in Finland. Yet its publication was halted because of the lacking interest from the users' part.

The popular media was indicated to have primarily an awareness keeping function. Visits to the actual sites are rather untypical while undertaking an individual administrative task, even though most of the administrators told that they might visit sites in order to inspect them whenever they are nearby. Basically the visits were considered to be useful, especially if the administrator herself is an expert in the period and type of the site in question. Generally speaking, the visits were deemed to be, however, relatively unfeasible due to the distances in the both countries, and the overall lack of time.

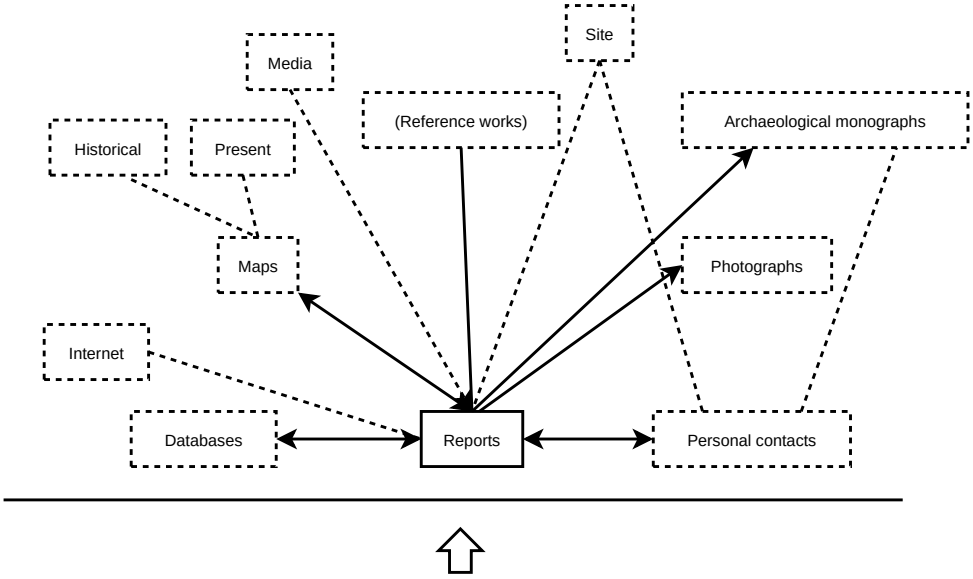


Figure 6.14: Information horizon of the cultural heritage administration work role

6.8 Infrastructural development

6.8.1 Work role

The last work role to be discussed within the frames of the present study is relatively atypical when it comes to traditional archaeological work and work roles. Generally speaking all archaeologists do develop more or less actively their working methods and techniques in all fields of archaeological research and practise. Concurrently the academia has produced new theoretical and technical innovations. Archaeologists have also been relatively active in consulting experts from the related scientific and technical fields, in matters concerning, for instance, land-surveying, natural sciences and technology. In contrast, the active development of the research, documentation and information management operations in the museums and heritage administration bodies was indicated to have been emerged only rather recently on a regular basis. Work, which is related to the development of infrastructures, has been done for decennia, but only recently it has received more emphasis. At the present, there is an increasing number of archaeologists and experts from the relating fields, who work in the cultural heritage administration bodies and develop working methods and e.g. information systems for archaeological purposes [A, C, F, Q, T, V, W].

The work, which is designated here as 'infrastructural development', consists of these aforementioned duties, which relate to the design and maintenance of the infrastructures for the cultural heritage and its management. Most of the identified activity relates to information management, information systems planning and the elaboration of both the field research and administrative work flows and techniques. Most of the infrastructural development activity takes place in national institutions [A, F, N, Q, T, W]. Yet some local organisations exercise similar work, although mostly as a secondary task, which is motivated primarily by the personal interest of individual employees [F, O].

People, who are working in the infrastructural development role, are typically educated as archaeologists, historians or in some other related academic discipline. Besides having an archaeological expertise, they combine the expertise with a strong interest in a related discipline and have acquired a relevant set of technical skills in earlier employment or because of a private interest.

6.8.2 Work process

Infrastructural development work consists of a highly complex network of various processes, which share the common aim of facilitating archaeological work and cultural heritage management. In spite of the internal complexity of the possible operations, the top-level activity resembles closely the iterative process, which was discussed in the context of the academic research (Section 6.5.2).

A typical work process commences with two alternative motivations. 1) The reasoning may be initiated by a problem, which requires attention. The problem might be an inability to document some archaeological features such as the complex details of some archaeological artefacts, buildings or structures [A, T]. On the other hand, the issue may relate to the making a routine effort (such as the field documentation and the post-processing of the data thereafter) more efficient [A, B, F, O]. Furthermore, the problem may relate to the management of information in the administration of archaeological collections or the sites and monuments [I, O, Q, R, W]. The second typical motivation for infrastructural development and innovation is that 2) the developer becomes aware of an attractive technique or technology. The development of measuring devices and information systems does, in a sense, call for utilisation also in the archaeological context and 'cause' new methods and infrastructures to develop further [A, B, C, T].

The development process itself is a complex procedure of reasoning, experimenting and error. Typical infrastructures, which emerge from the development work are sophisticated in comparison to the earlier ones, but in archaeology they do tend to accentuate the practical and usability issues over a technical superiority. The relatively strict financing of the archaeological and cultural heritage sectors, the needs to limit the costs of externally funded rescue archaeology operations, consensual nature of the archaeological research, and the preferences of the individual stakeholders, do seem to privilege short-term development projects with limited, benign, less innovative and unrevolutionary objectives.

Infrastructural development is both a collaborative and a solitary enterprise [A, T]. Much of the technical development is conducted in small projects by individual developers. The more wide-ranging, often regional and national policy orientated undertakings, are developed by groups, which bring together a wider spectrum of experts and expertise [C, I, Q, R, V, W]. The efforts to launch national archaeological information systems both in Finland and in Sweden are illustrative examples of such larger projects [C, I, R, W]. According to the interviews, the critique of many of these large scale projects is notably widespread in both countries. Local, more confined, and especially locally developed, systems were generally perceived to be more satisfactory [I, O, R, V].

The root definitions for the infrastructural work include the viewpoints of an infrastructural developer and a user of the infrastructure. The latter reflects a field archaeologist, administrator or a comparable agent who concentrates on the practical work. In many cases both the actors are a same person.

Infrastructural developer

Customers	Archaeologist; Cultural heritage professionals; Me
Actors	Me
Transformation	The archaeological work process, for instance, documentation, information storage, retrieval, the state of preservation of the heritage sites, or their presentation to the public becomes enhanced.
Weltanschauung	There is a lot to do in adopting new technologies and more effective methods into the archaeological work. Technology has no absolute value in archaeology, but it is definitely capable of enabling our everyday work.
Owners	Community of archaeologists; Society; Me
Environment	Community of archaeologists; museum/university/heritage board
I am working as an infrastructural developer to elaborate methods for making the work of my own and that of my colleagues more effective and efficient. My perception of the efficiency relates primarily to the achieved intellectual results, but I am ready to acknowledge also the economic aspects of my work. I think that there is much to do in developing our work practises and tools, even though I believe that the development efforts and the new techniques are uninteresting unless they are capable of producing practical benefits. This work is being done for the archaeology professionals and consequently to the society. A strong motivation for my efforts is the possibility to facilitate my own work.	

Table 6.12: CATWOE-analysis of infrastructural development (Infrastructural developer)

User

Customers	Me
Actors	Infrastructural developer
Transformation	New methods and techniques are being developed to make the archaeological work more easy, effective and efficient. Thanks to the new techniques, it is possible to concentrate on the important matters instead of manual labour.
Weltanschauung	I am doing important work. It is beneficial for me and my organisation that I will be provided with an effective infrastructure to support my work. I am not interested in technology, but in getting my work done.
Owners	Me; my colleagues
Environment	Organisation (museum, heritage board)
I have been employed to do archaeological research, administrative work or to perform in comparable archaeological heritage duties. It is beneficial to have new effective and efficient tools and work aids to make my job easier. I am not really interested in technology nor in learning new technical things. I think that the infrastructural developments should support my current routine, because I am the person who needs to judge whether these new apparatuses are fit for their job.	

Table 6.13: CATWOE-analysis of infrastructural development (User)

6.8.3 Interactions with information

Infrastructural development interactions serve a primary role of adapting current work routines, techniques and methods to the changing operational environment of the archaeological work. The related information interactions are polymorphic and typically relate to the archaeological primary work as secondary efforts. The aim of the infrastructural work is explicitly to elaborate the archaeological work process by discovering, testing and applying new innovations. The applicability of the approaches depend on the situation, both reactive to the existing and acknowledged problems, and anticipatory in the sense of exploring newly available techniques and tools.

Solve problems (Fig. 6.15): As an infrastructural activity, the problem solving relates to finding and *accessing* new possible solutions to various technical problems relating to, for instance, field archaeological documentation and collection management (a, b). The solutions are indicated to be typically of a very practical kind. They are often derived from the positive and negative experiences of the colleagues. The sources of information are usually diverse and comprise diverging technical and archaeological information sources, which are consulted with a varying degree of systematicity (c).

The precise criteria for applying or rejecting solutions depend on the individual developers. In a typical case, the central criteria seem to be the *topic* and *applicability* of the proposed technique. *Authority* is present less explicitly than the directly practical aspects of *topicality* and *applicability*, but its role becomes apparent through the indicated salience of peer-recommendations. The typical obstacles of solving technical and organisational problems are the *lack of resources* for making major investments, perceivable *resistance to change*, diverse *access problems* to technologies due to

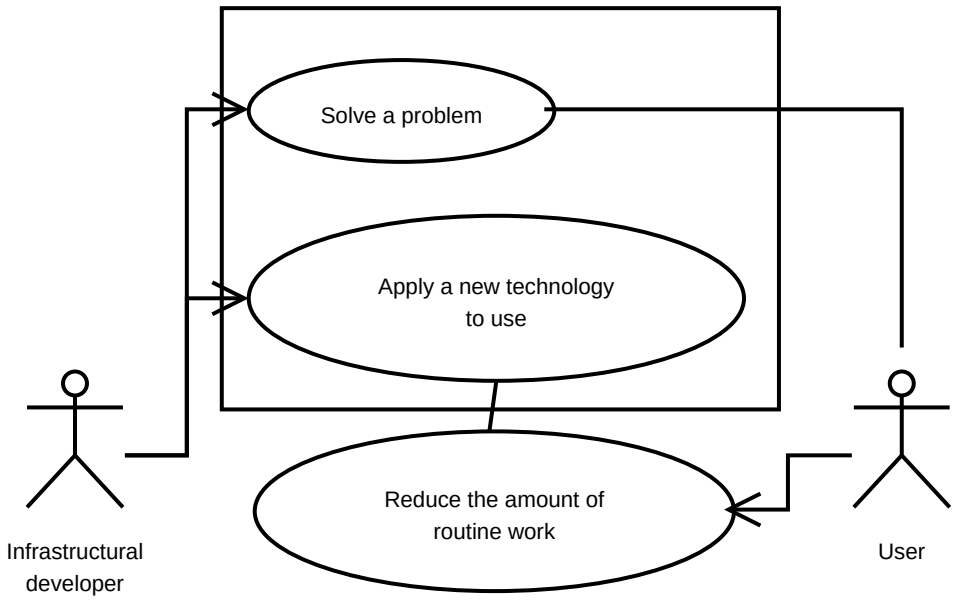


Figure 6.15: Use case diagram of infrastructural development work role

organisational causes and lack of resources, and the lack of appropriate adaptations of potential technologies to the archaeological ends (d).

a. Information behaviour: *access*, Method: *searching*, Mode: *recognition*

b. Objects interacted with: Level: *meta-information*, Medium: *multiple*, Quantity: *set of objects*

c. Common dimensions of information: Information object: *part*, Systematicity: *systematic* to *random*, Degree: *selective*

d. Interaction criteria: *topic, applicability, (authority),* Obstacles: *resources, resistance to change, access, appropriateness*

Apply new technology to use (Fig. 6.15): Archaeologists do borrow and apply both analytical, and information and communications technology related techniques from other disciplines. In spite of the frequent borrowing the interviewees tended to value most such tools and information systems, which were developed by archaeologists, preferably in their own organisation. The process of applying new technologies and working methods bears a close resemblance to the problem solving. An effective application presumes that information is (a) from several different sources, it is acquired by systematic searching, but also by *ad hoc* encountering (c) valuable pieces of data. The final choice between parallel possibilities depends on the topic and relevance of the proposal, and its technical and social feasibility in the present situation (d).

a. Information behaviour: *use*, Method: *apply*, Mode: *adaptation*

b. Objects interacted with: Level: *information*, Medium: *multiple*, Quantity: *set of objects*

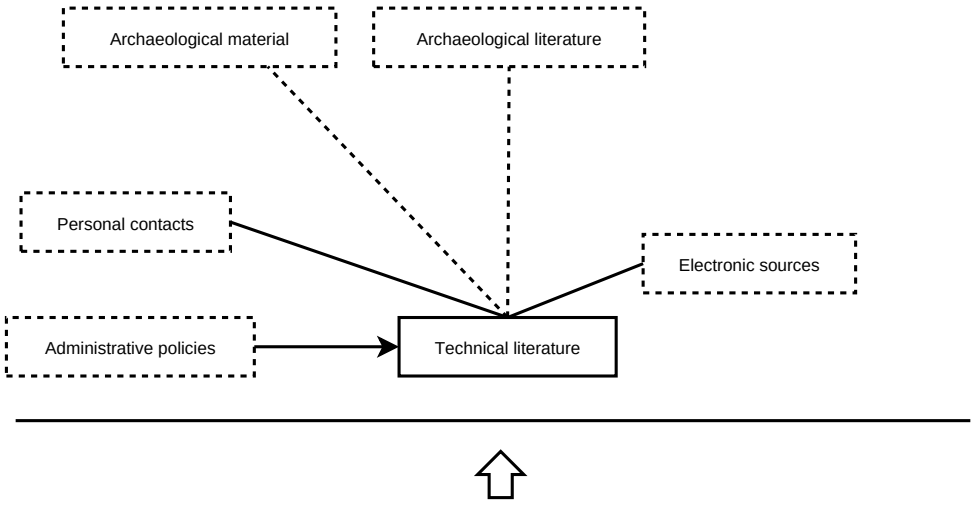


Figure 6.16: Information horizon of the infrastructural development work role

c. Common dimensions of information: Information object: *whole*, Systematicity: *systematic* to *random*, Degree: *selective*

d. Interaction criteria: *topic, applicability, (authority),* Obstacles: *resources, resistance to change, access, appropriateness*

6.8.4 Information horizon

Information horizon of the infrastructural developer work role (Fig. 6.16) is an amalgam of a typical archaeological and a 'technical', extra-archaeological information horizon. As one of the informants indicated, the most important literature from the infrastructural work point of view consists primarily of various operations manuals and technical documentation, instead of the archaeological literature. The archaeological scholarly literature and the archaeological materials relate almost completely to the evaluation and testing of the various applications of the infrastructures. Personal contacts are also important. Apart from the rather similar patterns of email use with the other earlier discussed work roles, the use of electronic sources and communication channels in infrastructural development work role is closer to the scientists and engineers than to the archaeologists (cf. [769][468]).

6.9 Work roles and work profiles

The occurrence of the different work roles in the informants' work profiles shows considerable variation. The validity of the observation is supported by the report of Carter and Robertson [148, 4] on the professional profiles in archaeology. The amplitude of how the work roles and work profiles coincide and the small size of the present sample do not allow distinguishing any definite patterns. Analytic observations of the grouping do suggest, however, a typical cooccurrence of academic teaching and research, field archaeology and antiquarian, and field archaeology and cultural heritage administration work roles. Work profiles, which are related to only one work role, are relatively rare. Even in those rare instances, the

informants indicated that they had earlier experience in several other archaeological work roles, either at their present employment or in the earlier work life. The actual distribution of the work roles is illustrated in table 6.14. The table is complemented with information on the nationality and gender of the respondents.

6.10 Summary

This chapter distinguishes seven major work roles in archaeological work: field archaeology, antiquarian, public dissemination, academic research, academic teaching, cultural heritage administration and infrastructural development. Each work roles is explicated by using root definitions (the CATWOE criteria), use cases, classification of information interactions and an analytical mapping of the role-based information horizons. The analysis serves as a functional classification of the archaeological work and information activity, which is directly usable in information design and architecture, and in the information systems development. The findings also form a basis for the further discussion of the information work, knowledge organisation and the role of virtual realities in archaeological contexts, which is commenced in the following chapters of this study.

Informant	Nationality	Gender	Field archaeology	Antiquarian	Public dissemination	Academic research	Academic teaching	Cultural heritage administration	Infrastructural development
1	SE	M	**X**	X	X				X
2	SE	M	X					X	**X**
3	SE	F				**X**	X		
4	SE	F		X		**X**	X		X
5	SE	M						**X**	
6	SE	M				X	**X**		
7	FI	M	**X**		X	**X**		X	X
8	FI	F	X	X	X		X	**X**	
9	FI	F	X			**X**			
10	SE	M	X			**X**	X		
11	FI	F		**X**	X				
12	SE	F			**X**				
13	FI	F	X			X	**X**		
14	FI	M	**X**	X	X		X	**X**	
15	SE	F		**X**					
16	SE	F	X			**X**	X		X
17	SE	M		**X**	X				
18	SE	F	X			**X**			
19	FI	F				**X**			
20	FI	F	**X**		X	X			X
21	FI	M	**X**						X
22	FI	M	X			X	**X**		
23	SE	M	**X**	**X**	X				
24	FI	M			**X**		X		
25	SE	M							**X**

Table 6.14: Distribution of work roles in the informants' work profiles. Note: the informants have been assigned temporary numeric identifiers to ensure their anonymity. SE = Swedish, FI = Finnish, M = Male, F = Female, X = affiliation to the work role, bold X = principal work role .

Chapter 7

Information work in archaeology

Information work does not exist in explicit terms in the archaeological context. Archaeologists are not acting in terms of creating, storing or retrieving information. Instead of information their work comprises “issues”, “problems”, “questions”, “materials”, “solutions” and “answers”. This conclusion of the empirical study is in accordance with the theoretical assumptions on the nature of the information work discussed earlier in Section 2.5.3. Information work is deeply embedded in the processes of work. It becomes apparent only in human activity, behaviour and the distinct uses of secondary objects (i.e. information sources), which are used to support the emergence of knowledge and understanding. The findings underline clearly the complexity of information interactions and the essential insufficiency of the concepts of ’information need’ and ’information retrieval’ (ref. [508]).

Because the organisation of the information work is implicit and interwoven with the everyday activities of the information workers, a complementary perspective to the system is needed. The information work was discussed earlier in chapter 6 from the point of view of the work roles. The work roles give a form and a purpose to the individual information interactions and to the layout of information horizons. The work roles do not, however, provide adequate means to dissect the functioning of the work system, but only its premises at the level of its structures and organisation. From the information management perspective, complementary instruments of analysis are needed, because to be effective, the scope of the information management activity needs to grasp not only the information and its organisation, but also its users and usage situations (Section 2.1). The present chapter augments the focus of the perusal to the individuals. The information source use and information behaviours are discussed within the life-world contexts and situations of the information users (ref. Section 2.7.5). Finally, the present chapter brings the findings and the discussion back to the level of organisation and work roles by explicating two critical success factors of the archaeological information work.

7.1 Information sources[1]

In spite of the general interest in archaeology and archaeological work, it appears that no comprehensive studies of the archaeologists' information work have been published so far. During the last twenty years, the number of studies on the information use in the humanities and social sciences has increased steadily (e.g. [560, 355 see note 7 for Thwala (1996)] [816] [735] [736] [116] [50] [495] [822] [824] [9] [772] [773] [67] [118] [774] [496] [760] [207]). Academic archaeologists have been included in the group of informants studied by e.g. Corkill [190], Stone [737] and Lönnqvist [495] (all the informants were classical archaeologists), [496, 71] (six archaeologists, none representing classical archaeology), but they represent a clear minority.

According to the findings of the present study, it is clear that the archaeologists work with a broad repertoire of information sources. The present section summarises the results of the interviews concerning the informants' use of different literary and digital source materials (theme 3). The discussion is focussed on the sources of major significance for the informants' information work according to their own direct statements and to a close reading of the implicit indications present in the interview record. Due to the fact that the qualitative correlation between the work roles and the used information sources is not distinctive, the usage patterns of individual sources is discussed from the perspective of individual source types. The notion of source denotes here both the consulted sources and the information objects (i.e. sources), which have been contributed and created by the informants.

7.1.1 Archaeological material

Archaeological material (artefacts, features, structures, non-artefactual organic or environmental remains [616], ref. Section 8.1.2) is used in field archaeology and antiquarian work roles as an information source on an everyday basis. The use of archaeological materials is frequent also in academic research and public dissemination. The informants emphasised the necessity of an adequate meta-information about the location and the date of a find, and a description of its appearance, material and measures. The descriptive information is needed for identification and it serves also in supplying a basic context for studying and evaluating the find and its function. Without the meta-information, the information value of the finds would be significantly lower.

The original archaeological material was indicated to be difficult to substitute with aggregates such as textual descriptions, drawings, photographs or three dimensional models. Visiting the museums and archaeological collections personally was perceived to be important by all of the interviewees. The informants saw the collections clearly as a form of 'capital' (ref. [118]).

The aggregates were, however, indicated to be better than nothing if the original materials proved to be inaccessible. Of the aggregates, the informants tended to prefer three dimensional models, photographs and drawings (in this order of preference). Secondary publications were considered to be useful, but they were generally seen to be lacking comprehensiveness and necessary details (cf. [495, 45]). Contrary to Lönnqvist's study (cf. [495, 46]), the bureaucratic problems did not seem to be a decisive issue for the informants interviewed for the present study. The difference may be explained by the better accessibility of the Nordic collections

[1] For the concept, ref. footnote on page 46.

(majority in the current study) compared to the collections in the Southern Europe (majority in [495, 46]).

7.1.2 Literature

The scholarly and professional literature has a central role in archaeology. Articles were preferred by those interviewees who worked with specific questions and duties, which did not encompass principal creation of primary information. Archaeologists tend to resort to the institutional repositories and personal contacts in acquiring articles. Most of the informants were members of the national archaeological associations, specialised associations, such as a society for medieval or maritime archaeology, or they subscribed to their journals.

As a whole, the significance of the journals (both printed and electronic) is clearly lower than in the sciences [496, 160] cf. [190], which compares to the general situation in the humanities [9, 112][773][771][825][468]. The general observation on the prevalence of the monographs in the humanities did not, however, receive unequivocal support in this study. Some of the informants indicated that they probably used more monographs than articles [V, S], but a significant group of them indicated that they actually used more articles [e.g. A, G, Q]. The findings of the present investigation seem to indicate that the actual preference between articles and monographs depends primarily on the precise nature of the purposes of the information work [A, O, P, S, U, X]. Journals provide focussed and often technical descriptions and studies of relatively confined themes [A, B, C, F, G, I, M, O, Q, V]. Articles were perceived to be more up-to-date [G, P, Q] Their significant role in supporting the general awareness function is also of consequence [A, O].

Most of the archaeological journals tend to be specialised both in terms of their subject and geographical coverage. In spite of the internationalisation of the research community and especially, of the broadening of the theoretical debate, archaeology is still a significantly national project in the Nordic countries. Some individual fields such as classical archaeology or archaeological science may claim the existence of a broader international community of researchers. Even then, however, the total number of participating researchers remains relatively low in comparison to the emphatically international disciplines such as the genetic science (ref. [722]).

Many of the specialist themes and sub-disciplines of archaeology have their own journals. Besides their importance within the specific sub-disciplines, some of the individual journals were indicated to have significance also for the informants, who were occasionally in need of specialist information outside the precise focus of their own expertise (e.g. antiquarians and field archaeologists). The stature of these publications varied, however, considerably. Similarly to the journals, some of the nationally or thematically distinctive monograph series were considered to be more relevant than the others. Their number and general significance seemed to be rather low.

A simultaneous reason and explanation for the diversity of the publications is the high proportion of the archaeological periodicals and literature, which are published in national languages. This pattern is related to the social organisation of archaeology, which is rather nation-centric. Besides being an expression of 'tribalism', the patterns of publication contribute to the continuance of the small scale cooperation by reducing the international circulation of the information. The Swedish informants regretted their lack of skills in Finnish, while both the Finnish and the Swedish mentioned the problems caused by their insufficient knowledge of the

neighbouring Slavic languages. The language skills would be highly relevant due to the proximity and similarity of the archaeological materials and material cultures in the Northeastern Europe.[2]

Monographs are typically favoured by those who seek extensive information on a relatively non-specific topic [e.g. O, Q], work in teaching or in public dissemination, and by those who need to connect a specific piece of information to a larger context. A good monograph is a comprehensive overview e.g. of a site or a theme. High quality illustrations and detailed information adds to their value as references (ref. [H]). The novelty of both the monographs and articles play a central role in their usability as information sources, even though it is not as important as in the sciences (ref. [769]). Compared to the articles, the use of the most important standard monographs is likely to be more intense. The interviews gave also indication of that the informants were more likely to return to a monograph than to an article. Especially the observations and eye-witness reports on past investigations and visits, which have been published in a monograph, retain their value over time even if some of the interpretations and propositions will be eventually rejected.

Compared with the scientists and, to a degree, with the social scientists (e.g. [254][768] [366]), the informants were rather infrequent users of electronic literature. The most of the informants acknowledged the increasing significance of the electronic resources and were aware of the growing number of the relevant journals and data sources available online [e.g. G, M] (ref. [68]), but used them only sporadically.

Besides the apparent persistence of habits, another clear explanation for the comparatively low usage of electronic materials is their relative scarcity in several specialist fields of archaeology. The informants who had crossdisciplinary contacts and research interests, which coincided with the natural sciences, emphasised the importance and value of the electronic data services. They also contrasted the abundance of the electronic data sources in the sciences to their scarcity in archaeology [D, N, V]. The present evolutionary phase of the electronic journal use might be related to the "evolving" phase in the categorisation proposed by Tenopir et al. [769], even though the present study does not provide data for comparable longitudinal comparisons.

7.1.3 Reports

Archaeological investigation reports were interestingly mentioned to be important far more often than they were used and actually stated to be useful. A typical comment was: "I use them less than I could think of" [e.g. O, Q]. The typical problems with the reports included that they usually are too specific on small excavations, too general on large ones, and that the reported results are not very well tied into a larger context of reference. In several occasions the reports were stated to be difficult to access, because the consultation required travelling to the capital city or another distant place.

Regardless of the problems, a report was seen as a primary source of archaeological information on a particular excavation and site. Secondary publications were often seen as abridgements, which did not give enough information on the subject

[2] As the recent studies of the multi-lingual information retrieval have demonstrated, the problem is not only a question of understanding the foreign language texts, but also a question of being capable to formulate relevant queries, for instance, in collection databases. The effectivity of retrieval and searching is not adequate in non-native language searches even if the language itself is comprehensible to the reader (e.g. [454]).

matter to be useful in further scholarly considerations. The principal importance of the reports as first hand accounts was also emphasised by the academic educators. They also underlined that it is necessary that the students use original reports in order to become acquainted with this particular type of information source [M, Z] (ref also [606]).

7.1.4 Academic theses

The perceived role of theses and dissertations as information sources shows some variation. Basically, most of the informants agreed that the value of a thesis is based on its contents. The scholarly nature of a thesis does not affect its quality as a source of information. Field archaeologists tended to be interested in everything that might touch upon the subject of their research. They were not generally emphatically concerned about the *formal* qualifications or level of the theses. An undergraduate essay was assessed to be potentially useful not unlike a doctoral dissertation. Academics and, interestingly, younger archaeologists tended to be more sensitive to the good formal qualifications (i.e. grade) and the high, preferably doctoral, level of the theses [D, G, Q, V, Z]. Considering the usefulness of the theses, some of the interviewees remarked that the formal scholarly criteria did occasionally make a thesis difficult to read. Unpublished theses are often also rather difficult to obtain, which necessarily reduces their usability as an information source.

7.1.5 Reference works

Specialised reference works are relatively scarce in the Nordic archaeology and in many of its special fields [Z]. The annual Nordic Archaeological Abstracts (NAA) monographs were the prevailing general reference mentioned by the interviewees. *Kulturhistorisk lexikon för nordisk medeltid* (The Lexicon of the Cultural history of the Middle Ages in the Nordic Countries) was mentioned by several Swedish respondents as a basically non-archaeological, but still important general reference work on the early-medieval and medieval culture in Sweden [O, R, S, G, V, J, K, N].

In spite of the scarcity of archaeological reference works, the informants could rely on the relevant reference works from related disciplines, such as shipbuilding in the maritime archaeology. In many cases some meticulously compiled standard works such as comprehensive dissertations or monographs may serve as a reference work [H, V]. In comparison to the classical archaeology (in [495, 75]), most of the special fields of archaeology lack a similar comprehensive apparatus of reference works.

7.1.6 Databases

Archaeologists are relatively active users of small scale databases, which are specifically built for their personal needs or for their home institution. Most of the informants described that they work with the proprietary databases of their own institution or small databases made by themselves for their very specific research and reporting needs. The national heritage authorities have centralised collection and site registers although they tend to be far from being comprehensive. Old legacy systems exist and are being used together with the new systems. Besides the several central repositories, additional cataloguing may be done in yet another system in order to serve some special needs, such as the maintenance of a loans inventory. The existence of multiple databases is largely explained by the chronic lack

of funding for integration, conversions and cataloguing of the unregistered data. Most institutions have begun to register their new data in electronic repositories, typically from the late 1990's onwards. The database is typically parallel to a physical archive [O, P, Q, R, V, W, A, C, D, F, I, J, N]. Unfortunately, the quality of the new repositories shows considerable variation. As one of the informants indicated, not all of the data entry work has been professional and consistent [D].

In spite of the immanent shortcomings, the databases were considered to be vital tools especially in the cultural heritage administration. In general, the cultural heritage administration work role correlated with the most active usage of databases and electronic information resources. Individual respondents indicated that they use mostly the databases, which are published and maintained by their home institutions [e.g. A]. Most of the relevant external databases cover secondary subjects such as the natural sciences, not archaeology. Library OPACs and web pages with contact information were also mentioned as useful databases [e.g. P, Q, R, T, V, W, X, Z].

The overall lack of useful and complete archaeological databases was widely acknowledged. The same notion applies to all forms of electronic media. Only one informant, who works with a specialised natural science topic in the field of archaeological research, was a heavy user of electronic resources. In spite of the scarcity of the resources, many of the interviewees were enthusiastic about them (cf. [495, 75]). Part of the enthusiasm may be credited to the attempts to satisfice the interviewer, because the invitation to the interview (Appendix A) could be read as an indication of a special interest in the computerised information systems. The tendency of satisficing the interviewer is, however, unlikely to ground all of the optimism. The interviews gave a clear indication of the generally positive experiences and expectations of the use of electronic data and information resources. Therefore, it is suggested that these positive attitudes should be taken as an explicit impetus to work further on the computerised information management and the development of electronic information resources for archaeological use.

7.1.7 Plans and maps

Topographic and thematic charts and excavation and site maps as well as profile plans were used by all informants. Their importance appeared to be lower in artefact centric work [B, G, I, Z] than in fieldwork, cultural heritage administration or landscape related studies. The interviewees expressed, however, that the understanding of the spatial relations and dimensions is necessary in all archaeological work, and it is based on maps and plans. The cartographic material provides vital information on the stratigraphic and subsequently chronological relations, spatial distributions and relations of the points of interest. A map also helps to situate and contextualise the entire intellectual process, which is related to a specific site.

The essentiality of the plans and maps is accentuated in the field archaeology. Excavating archaeologists use multiple small scale plans and maps to document the excavation. Surveyors use a variety of detailed and larger scale topographic, historical and thematic maps for identifying potential sites [F, N].

7.1.8 Photographs and the moving image

Photographs are another central instrument of archaeological communication (cf. unlike in [496, 161-162]). Every single archaeologist uses almost invariably photographs. Apart from a visit to an archaeological site or a firsthand contact with a

find, the photographs are the most important instrument for mediating information on the primary materials.

A couple of informants had considered using moving image in field documentation. Only a few had any direct experiences and for the most, the idea of using a video as an information source in archaeology, was a new one. Most of the trials actually done in land archaeology were purely experimental and primarily directed towards producing video footage for public dissemination purposes [P, N]. In contrast to the land archaeologists, the maritime archaeologists use video extensively. The primary reason to resort to the moving image is the limited time, which may be spent on an underwater site. The use of a video camera allows continuous documentation throughout the dive and thus maximises the input [2 respondents][3]. The theoretical possibility of covering an investigation completely by filming and later rewinding the process, attracted several land archaeologist informants [e.g. E, P]. The problems of archival and browsing would, however, limit the usability of such a comprehensive video documentation.

7.1.9 Social contacts and the practises of information sharing

In spite of the importance of the physical and literary source materials, the most significant source of information for the interviewees were the social contacts to colleagues and experts of several related disciplines. Because of the convergence of practical work and academic research, the archaeologists work only seldom entirely alone (unlike e.g. historians [773]). The stereotype of 'lone humanities researchers' is not accurate at least in the context of archaeology.

Even if the academic and research oriented archaeological activity itself would involve considerable periods of independent work, it does not imply that the researchers would not use or be benefited of informal communication (ref. [496, 66]). Excavations are a group effort both practically and intellectually, although the ultimate intellectual authority is held by the director of the investigation. The academic research in archaeology is partly an individual enterprise, although the crossdisciplinarity of the data tends to require occasional consultation of the colleagues and other specialists. Similarly the work in public dissemination, academic education, infrastructural development and cultural heritage administration is a collective effort. Individuals are free to make their own decisions, but the colleagues are consulted is such a frequency that it maintains a strict collective control of the intellectual work. Colleagues provide direct information, pointers to things they are aware of, affirmation and confirmation. The role of the community of colleagues as an important source of information is emphasised, because the formal publication channels are relatively scarce, the resources for an adequate and thorough publication of the research results are generally lacking, and the number of active practitioners in archaeology is relatively small.

If the present findings are considered in the light of the conceptual models of information sharing, which have been based on the social exchange theory, the role and complexity of the social sharing in archaeology is immanent. According to the information science oriented approaches, the sharing of information resembles a system of giving and receiving gifts in a manner, which is based more on an expectation of emerging benefits than on the direct needs and goal settings. The dynamics of information sharing resemble considerably the complex systems of

[3]The exception of not using letter codes is motivated by the securing of the anonymity of the two respondents.

giving gifts described in the early societies [515][216].[4] The strategies of sharing utilised in the professional archaeological work groups, and the teams engaged in field archaeology projects and other similar undertakings, do seem to bear a noticeable resemblance to the strategies and motivations of sharing described by Cronin [200].

Only a few academic research, teaching and field archaeology oriented archaeologists indicated that they relied frequently on information specialists such as librarians. These results do conform with several other investigations and observations on the (academic) information behaviour (e.g. [460, 76][376][691]). The situation was slightly different with the informants who acted in the roles of public dissemination, antiquarian and cultural heritage administration, but the overall picture may well be described as being "disappointing" (ref. Hjørland in [376]) from a library and information service protagonist's point of view. Many informants indicated that they consulted frequently information technology specialists and specialist of a particular type of information, such as of the natural scientific, geographic or statistic data. The informants who did indicate that they consulted information specialists during their explicit information seeking, shared the characteristics of being typically elderly and less computer literate, and of working in a relatively large public organisation. Academics consulted specialists most infrequently. The reluctance to consult an information specialist seems to correlate with a a rather narrow perceived horizon of relevant information, existence of well-established and stable publication and information dissemination channels, small size of the closely relevant archaeological community, and the traditions and habits of esteeming the personal information seeking and access. Several informants acknowledged that they might benefit of consulting an expert in the information seeking matters, but were altogether rather dubious whether they would do so in the future. The results compare well with the respective observations of Steinerová [730] and Singh [694, 224-225] (ref. also Pasanen [576, 58 and 71]) that the libraries and information professionals do need to struggle with the problems of new information environments, service encounter, and identities and visibility in the fast evolving processes of information access, which have shifted the focus to the users' desktops and make the information access providers increasingly transparent in the process of information seeking and use.

7.1.10 Summing up

In summary, the core of the sources used by archaeologists consist of archaeological primary materials (e.g. finds and sites), scholarly literature and personal communication. Registers, catalogues and databases were indicated to be of a direct importance, but most of the informants indicated that the records tend to be lacking in comprehensiveness and often also in the relevant information. The general patterns of information source use are in line with the findings of the earlier studies on the humanities scholars. The crossdisciplinary and scientific tendencies of the archaeological practise became apparent on the level of individual information sources and information seeking archaeologists. The general tendency to make distinction between the primary and the secondary materials, a variety of utilised information sources, and the long lifespan of the relevant literature seem to be, however, a common characteristic shared by the archaeologists and the majority of the humanities

[4] In information science contexts the theory of exchanging gifts has been used for instance by Cronin [200] and Talja [759], and perhaps most extensively by Hall [348].

scholars [773][774]. In this respect, archaeology is clearly a humanity in Finland and in Sweden, as the placing of the departments in the university faculties suggests.

Basically all source materials, including the archaeological material, serve a dual purpose of being both information containers and pointers to new information. Sources may contain direct links such as bibliographical references, but also indirect references to potentially interesting follow-ups such as the material, find spot and the form of an object. Popular information sources such as the newspapers, television and magazines were considered to be of a relatively little use. Informants, who work in the cultural heritage administrator role, gave some weight for the news broadcasts and newspapers for keeping aware of the public debate and various public matters, such as the current land use plans [e.g. C, W]. Otherwise their relevance was considered to be low, apart from providing some rare pointers to other sources.

A general remark made by many informants is that published, accessible and altogether existing archaeological information is only sporadically available. The problem is especially immanent in field archaeology. Reports on earlier investigations may be entirely non-existent or consist of some scattered notes, uncatalogued finds and fragmentary data (e.g. [628]). The occasionally lacking documentation, the small number of researchers, and consequently of the publications, in many special fields of archaeology, limits the total amount and quality of the information resources. These kinds of shortcomings show a striking resemblance to the observations of Ocholla [560] in a third world context. Like the academics in a third world university, the archaeologists are forced to resort to alternative information acquisition methods. Archaeologists need to congregate around the available resources (cf. the library in Ocholla's study [560]) and to forge them to fill the place of the inexisting resources in their communal discourse. This kind of a formation of the information use behaviour is natural, but it signals of an inefficiency of the general information process in the profession. If the financial and practical possibilities are available to conduct investigations, there should be enough resources and pressure to finish the documentation process adequately and to maintain a proper level of information management.

The archaeologists' source use is specific to the purposes of the work and it varies according to the situation and context of the information work. Besides the basic information horizon level observations, the information source use shows some distinct work role specific variation on the level of the characteristics and the specificity of the resources. The information source use tends to be more specific, and in contrast, more general in some of the work roles than in the others (academic research, antiquarian, field archaeology, infrastructural development, cultural heritage administration vs. public dissemination, academic teaching). Similarly the sources are consulted for different types of information depending on the work role, even if the source itself was the same one. Academic research seems to be the only exception to the general rule, which covers most of the practitioners and educators. Information source use tend to be specific to the current research topics, but the information itself may serve multiple functions in its various contexts and situations. The nature of the information is determined by the specific research questions, their meaning, purposes and values, not the horizon of the work itself.

7.2 The landscapes of the information horizons: the layout of transmitters, carriers and receivers

The present study uses information horizon as an instrument for explicating the information resources, which are involved in the information interactions. Besides explicating the resources, the information horizon maps provide a method for visualising the work role and information interaction specific processual relations of the resources. The present section explicates the patterns of how the information horizons (see Section 2.7.4) relate to the archaeological work and information work through examining the attributes and organisation of the involved information objects (derived primarily from the interview themes 3 and 4, ref. Section 4.5). It became apparent during the study that the information horizons do converge with the work roles, even though there is no apparent linkage between the work roles and the use of individual information sources.

According to Sonnenwald, the information horizon is a space where an actor can act [707]. Relative to the framework of information work, an information horizon is a space where the work resides and which explicates the information 'instruments' used pursue it. The individual information sources may be expected to serve very distinct purposes and to carry significantly diverging meanings and values during the process of work. Yet the complete map of the information horizon, which comprises all the individual sources, may be expected to resonate closely with the patterns of the work itself. The individual sources and especially the emerging patterns form a constituent part of the activity.

The information horizons are in the centre of the organisation of work in archaeology. Archaeologists work with a broad variety of information objects, but the core of the information sources consists of a fairly limited set of materials. Therefore it is not the materials themselves, which make the work roles distinct. The source use becomes distinct due to the organisation of the information horizon and due to the existence of focussed starting resources in the information seeking process [710, 13]. The notions of starting resources, balanced resources and ending resources, or *transmitters, carriers* and *receivers* [710, 13] have been used within the information horizons theory to denote information materials, which are typically used first, in the middle and in the end of the work role related information processes. Transmitters mark an entry-point of information interactions, the carriers are used through the subsequent interactions and the ending resources represent the objects, where the information interactions typically end.

The information horizon of the **field archaeology** role is centred around a site or an area of archaeological interest. The horizon spreads out from the geographical location and the period of time to grasp the relevant information in a diversity of sources. The information work is carried on by a congruent use of diverse resources, cyclical returning to the starting point and by a constant process of information acquisition through observation. The process is essentially cyclic and iterative. It is lasting as many iterations as the obstacles of the *access* information interaction allow.

The **Antiquarian** role works with a horizon, which shares the characteristic of focussing on distinct pieces of archaeological evidence, with the field archaeology work role. The perception of the sources typically starts from the local collections database (*transmitter*, instead of focussing on a geographical location or a site, cf. field archaeology) and spreads out to grasp a spectrum of archaeological literature and other information sources (*carriers*) related to an artefact. The information hori-

zon of the antiquarians is organised around iterations, which start from the antiquities register or a collections database. The process does, however, only seldom end at the database. The most typical *receiver* is the artefact, which served as the impetus to the seeking process. The field archaeologists and antiquarians tend to consult sources on the primary purpose of finding descriptions of their objects of study and of relevant comparative materials. Field archaeology refers to the descriptions of the excavated site or surveyed area and to the corresponding observations, which have been done elsewhere. Antiquarian work role focusses, on the other hand, on the seeking of artefact or artefact group specific descriptive information.

Public dissemination professionals are primarily interested on broader archaeological themes than on individual pieces of data. A typical *transmitter* is the general archaeological and historical literature, which is capable of shedding light on a particular phenomenon such as the clothing in the Middle Ages, childhood in Viking Age Sweden or the life and times of Saint Bridget. The process carries on to the literature (*carrier*) and typically ends with a finding of suitable archaeological objects for display or publication (*receiver*). Public dissemination work role directs towards communicating archaeological information. The information, its authenticity and accuracy are valued, but to have an impact, the sources and the information itself calls for the presence of an affective element. The information has to have a meaning in the context of its designated audience in order to make a difference.

The information horizon of **academic researchers** places an equal emphasis on the archaeological material as a plausible entry point. However, unlike the rest of the discussed work roles, the scholarly research tends to have notably fluctuating entry points (*transmitter*). The horizon consists of a fairly broad variety of scholarly information sources, which are being used according to the actual information needs. The needs and the subsequent process of information seeking is likely to start with an unequalled insight instead of a directly phraseable query. Information seeking for scholarly purposes shows visible patterns in respect to the breadth and depth of the efforts. The patterns are however, significantly mixed in comparison to the other work roles (*carrier*). Similar to field work research, the scholarly information process of the academic research work role tends to end only when practical, either oncoming or preplanned, limits are reached (*receiver*).

Academic teaching relies broadly on the current scholarly literature. The role of well-known and on the other hand, locally available, literature is central both as a starting resource (*transmitter*) and as an actual information source (*carrier*). The notion of 'being well-known' is rather complex. A book or an article may become well-known to an individual who acts in the academic teaching work role by personal recommendations, public exposure within the scholarly community, in reviews and critiques, and to a degree, in advertisements. An individual information process of planning and running a course ends with the literature (*receiver*), although the overall process of academic teaching may be seen as an illustrative example of iteration and continuity. Academic teaching expects authoritative academic information. Besides the actuality and authority, the practical limitations of time and resources make the teachers to look for processed and compact summarising information on the current topics of the courses.

Cultural heritage administrators rely heavily on the archaeological investigation reports, and secondarily, to the institutional databases as *transmitters* and consequently as *carriers*. Unlike in the antiquarian role, the database work does not carry on independently with the literature and other complementary sources in the cultural heritage administration. It acts more typically as a surrogate, and as an in-

strument to find the relevant reports. The spectrum of the used information sources varies significantly depending on their availability and the perceived importance of the information interaction. Typical *receiver* in the cultural heritage administration related information horizons is a relatively detailed description, which effectively fulfils or exceeds the imminent needs.

Infrastructural development work role relies on a rather different information horizon than the rest of the work roles. The information sources as well as the typical *transmitters* are mostly technical and methodological. The developers seem to rely only secondarily on the core of the archaeological sources. As the research and development work in general, the information horizon of the infrastructural development evolves in an iterative fashion. Basically, the same sources may function as transmitters, *carriers* and receivers. A *receiver* is often a source which is consulted at a specific stage of the process where it is able to explicate a comprehensive answer to the original query either self-sufficiently or complemented with information from the sources, which had been consulted earlier. Similarly, a receiver is a source, which crystallises the unsuitability of a method or technology for an immanent application.

The cultural heritage administration and infrastructural development work roles are interconnected by the evaluative character of the work processes. The archaeological sites and the community development are confronted all the time. The decision-making enjoins educated evaluations of the importance and meaning of the involved sites. Infrastructural developers have to make estimates of the value of the new approaches and methods, and their suitability for the archaeological practise.

The relevance of explicating transmitters, carriers and receivers in the information horizons is in their indicative value on the purposes, meanings and values of the information work and its related work. The organisation of the information horizon converges closely with the associated work roles and the related system of information work. Carriers do seem to give indication on the qualities of the information needs. Receivers, their nature and existence, appear to betoken the depth and continuity of the interest of the interaction.

The role of the transmitters is constituent within the frame of the present study. From the information management perspective, a useful infrastructure needs to implement the whole information horizon and to enable browsing and searching within its entire scope. Transmitters seem to be, however, especially good in indicating the motivations and entry points behind the work related assignments, thus giving a relatively good indication on the types and qualities of the information sources and repositories, which are likely to be useful in the context of the work role.

All archaeologists interact with information of a broad quantitative range. The focus of interest may be a tiny sherd of an artefact from a small site. The scrutiny may grasp, on the other hand, large quantities of sites and finds, predefined collections or databases of information, or it may cover, theoretically speaking, everything. Basically, all archaeological work grasps individual information objects: sites, areas and single artefacts. The constituent distinction between the different work roles is in the organisation of the information objects. Antiquarians and cultural heritage administrators work particularly with data, which is organised according to some principle. The organisation may reside in varying forms, in a collections database or on a map. The distinct feature is, however, that the organisation exists and the focus of the information horizon is an entity of information. The

information work is centred around a notion of 'what is' even if the work is evolving constantly. Field archaeologists contribute to the emergence of organisation by documenting sites and finds. However, for a field archaeologist, the perceived site is still essentially a sample of 'what might be'. Similarly, the public dissemination, academic research, academic teaching and infrastructural development work roles concern themselves with equally indefinite sets of information objects, where an individual artefact or site is an instance of a larger phenomenon.

The table 7.1 summarises the observations made on the work role related information horizons. The columns recapitulate the work roles, transmitters, the nature of the first accessed information (descriptive, affective, summarising or evaluative), its specificity and the primary mode of access. The analysis reveals three broad categories of 1) specifically description oriented (field archaeology, antiquarian), 2) general subject specific (public dissemination and academic teaching) and 3) evaluative (Cultural heritage administration and infrastructural development) lines of information work. The characteristics of the three classes coincide in the academic research work role, which may adapt any of the three approaches depending on the research question.

The analysis of the layout of an information horizon by identifying transmitters, carriers and receivers provides some grounds to argue that the relative homogeneity of the archaeologists' information use, is largely ostensible. A significant amount of the uniformity may be traced to the rather limited practical choices and possibilities of selection. Especially in Finland and Sweden, the communities of the archaeologists are relatively small and only a small proportion of all work is published and have a wider distribution. The subterranean flow of information through personal communication and participation is fundamental for the success of the information work. Therefore, it is plausible to state that the archaeological information work is essentially a social matter.

The personal experiences and first-hand knowledge are an important source of information and meta-information. They are consequential to the social dimension of the information work. The experiences form the substance of the socially communicated information. The excavations are a primary example of socialisation, where the personal experiences of all participating archaeologists are merged together. Experience is of consequence also in the administrative assignments. Experienced individuals, whose work comprise cultural heritage administration, are often able to rely largely on their existing knowledge when it comes to the giving of opinions on the necessity of archaeological investigations [P]. This personal knowledge was typically expressed in the interviews in a manner: "we know that" or "it is known that in this area". Respectively, the less experienced archaeologists indicated that they have to rely more on the available second hand information [C cf. P].

7.3 Information behaviours

The present study perceives the human information behaviour as a fluid, life-world wide phenomenon, which grasps the essential contexts of the human sphere of experience. The human information behaviour is situated in an information horizon. It emerges through the information interactions. The following sections present and explicate an analytic grouping of the individual information work behaviours identified in the empirical material of the present study. The grouping is based on the information source use and information horizon profiles of the individual in-

Work role	Focus of interest	Principal transmitter	Information	Specificity of information	Quantity of objects	Mode of access
Field archaeology	Site	Investigation report	Descriptive	Specific	Set	Search/browse
Antiquarian	Artefact	Collections database	Descriptive	Specific	Database	Search/browse
Public dissemination	Subject	General literature	Affective	General	Set	(General level) browse
Academic research	(varies)	(varies)	(varies)	Specific	Set	Search/browse
Academic teaching	Subject	General literature	Summarising	General	Set	Browse
Cultural heritage administration	Site	Investigation report	Evaluative	Specific	Database	Search
Infrastructural development	Method	Technical literature	Evaluative	Specific	Set	Browse

Table 7.1: Aspects of work role specific information sources.

Informant	Intensity of source use	Directedness of information activity
a	2	**contributor**, user
b	2	**contributor**, user
c	2	**user**, contributor
d	3	**contributor**, user
e	4	**contributor**, user
f	1	contributor, **user**
g	5	**contributor**
h	5	contributor, user
i	2	**user**
j	4	**contributor**, user
k	5	**user**
l	3	**contributor**, user
m	2	**user**, contributor
n	3	**user**
o	3	**contributor**, user
p	5	**user**
q	3	**contributor**, user
r	3	**user**
s	4	contributor, **user**
t	2	**contributor**, user
u	2	**contributor**, user
v	5	**user**,contributor
w	4	**user**
x	3	**contributor**, user
y	3	contributor, user

Table 7.2: Information source use and activity in the individual interviewees' information behaviours. The letter codes have been reassigned for the present table. Bold typeface indicates emphasis of the behavioural characteristic. Intensity of information activity has been estimated on analytical scale 1 (active all-round information interactions), 2 (active somewhat directed interactions), 3 (active within own personal domain), 4 (active within a definite set of sources), 5 (principal reliance on information encountering) .

formants, which are on their turn based primarily on the "information source use and perception" (theme 3) and "information creation case-study" (theme 4) sections of the interview (ref. Section 4.5, detailed description in Sections 7.1 and 7.2. The fundamental components of the grouping were the patterns and preferences of information use and creation, and the manner in which the informants were engaged and contributing to the archaeological information work according to the general and work role specific purposes, goals and meanings of the entire system of archaeological work.

The analysis of information source use (ref. Section 7.2) indicated that the principal variations in the individual information behaviours are linked to the breadth and complexity of the information horizons, and to the activity and directedness of the information (source) object related interactions of the individual informants. The intensity and directedness of the information source interactions is summarised in table 7.2.

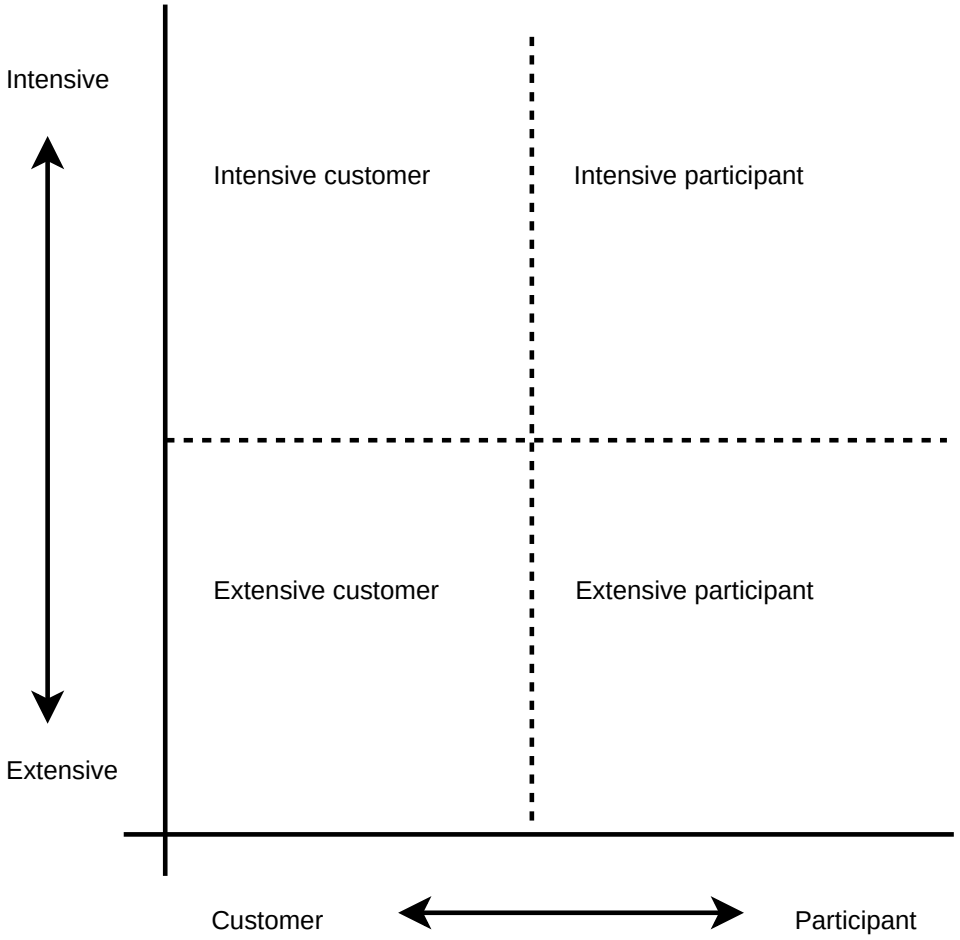


Figure 7.1: Archaeological information behaviours

7.3.1 Information behavioural groups

The analytic grouping of the information behaviours assumed in the present study corresponds broadly with the findings of the earlier investigations reported in the literature. In spite of the evident differences, which are caused by the largely varying methodologies and research approaches, several studies have demonstrated rather consistently that the information behaviours tend to cluster around the activity and depth of engagement in the information interactions (e.g. [361][572]). The analysis of the interview record provided ground for establishing a set of four broad behavioural groups based on the notions of intensity versus extensity, and participation (use and contribution) versus customership (use) of the behaviour (ref. Table 7.2). The groups and their characteristics are illustrated in figure 7.1.

The notion of intensive and extensive roles characterises the depth and specificity (intensive) versus breadth and generality (extensive) of the information interactivities. The labels 'customers' and 'participants' do correspondingly refer to the orientation of the information activities. *Customers* tend to work with already existing secondary and primary level information. This information may be further

Facet	
Method	access and create
Mode	documentation, (contextualisation)
Level	information
Systematicity and degree	systematic; exhaustive
Interaction criteria	accuracy, importance
Obstacles	resources, time, training

Table 7.3: Characteristic information interactions: extensive participants

processed, altered and disseminated. The behaviour of the *participants* is directed to the work with primary materials and to the creation of information resources for customer processes. It is important to remark that the notion of 'customers' does not designate passivity or non-participation in an absolute meaning. The distinction serves to indicate the differences in the level of active participatory role in the general archaeological information process discussed further in section 7.5. The groups and the constituent factors, which affected the clustering in the present study, are discussed in the subsequent sections.

7.3.1.1 Extensive participants

The distinctive characteristic of the group seems not to be the demographic variable, but the typical professional duties, which focus on the basic research, information seeking, documentation and information creation. The group of extensive participants tends to value any available information. Solidity of the information is an issue, but as long as the source is traceable, the origin is not of a primary importance. Compared to all informants, the members of this group are generally younger, they are in the beginning of their careers and their knowledge is in a constant state of negotiation. The typical characteristic of this group is that they are often unsure where it is and where it is not worth to seek information and whether they know enough or not. The level of their self-possession is generally rather low and they are doubtful about their information use. Their information seeking does not necessarily rely on information encountering, but they do obtain relevant information through accidentally coming across with something interesting. According to information use strategies explicated and discussed by O'Connor et al., the information behaviour of the extensive participants may be illustratively described to be a typical behaviour foragers, who resort to the strategies of picking, coupling, browsing, glimpsing, tracking and wading in the stream (ref. [561, 126-135]).

7.3.1.2 Intensive participants

This group consists of individuals who often concentrate on one distinct subject or theme, and pursue their interactions within the scope of that particular topic. The intensive participants are more likely to read articles than monographs, because they value specific and compact information instead of ample overviews. The active intensive information workers are likely to use specialised sources and compendia. Self-efficacy in this group is relatively high and the role of information encountering in overall information activity is relatively low. Their information activity is best described as focussed, directed and intensive. Referring to O'Connor

Facet	
Method	access, organise, evaluate, create
Mode	recognition, specification
Level	information
Systematicity and degree	systematic; selective (exhaustive)
Interaction criteria	accuracy, representativity, exhaustivity, contingency
Obstacles	resources, information overflow

Table 7.4: Characteristic information interactions: intensive participants

et al. the typical foraging strategies for an intensive participant are hunting, coupling, indexing, berrypicking, expert hunting and handling [561, 126-135].

7.3.1.3 Extensive customers

The members of the extensive customers group tend to use all available information, which is of a sufficient quality. A typical example of a member of this group is a professional who has an option, but also the necessity to skip impossible subjects and to steer the information work to a practicable direction. If it seems to be impossible to produce an exhibition on stone age fishing practises, the subject is altered to a something more feasible. This group tends to let the information 'move' and relies on receiving a relevant piece of it. Extensive information customers do not rely solely on information encountering, but they do benefit significantly of a possibility to find new things semi-accidentally. The extensive customers benefit of the so called subterranean flow of information, i.e. the unofficial exchange of article manuscripts, photocopies, emails and other pieces of information [767], even though the expanse of this flow makes it hard to follow and consume.

The level of self-efficacy is mostly high in the group. Extensive customers are confident that they grasp necessary amount of relevant information through extensively consulting a broad variety of information sources. The group members have sometimes managed to establish themselves in a comfortable position where the information is available to them. The members of the group need to be somewhat active in information seeking and use, and they are typically at least moderately contented with their efforts. The settling of an individual into one of the two groups of customers (intensive or extensive) is essentially dependent on the systematicity and successfulness of the activity. Extensive customers forage using the strategies of browsing, grazing, glimpsing, satisficing, bricolage, scavenging, tracking, sitting and waiting, and wading in the stream ref. O'Connor et al. [561, 126-135]).

7.3.1.4 Intensive customers

The group is characterised by an expert figure, who is concentrated on distinct matters in her work. She uses a lot of expert and collegial information sources and seeks semi-actively information, resorting mostly to the available social contacts. This group of people has established themselves in a social world, where they know the important people and the relevant information sources. Correspondingly, the relevant people know them and inform them of new pertinent information. In addition

Facet	
Method	create, modify, disseminate, organise, comprehend, use, access
Mode	presentation (incl. different modes such as speaking), scanning,
Level	meta-information
Systematicity and degree	random; selective
Interaction criteria	importance, authority
Obstacles	appropriateness, information overflow, resources

Table 7.5: Characteristic information interactions: extensive customers

Facet	
Method	access, evaluate, disseminate, organise, preserve
Mode	comparison, compilation, recognition, specification
Level	meta-information
Systematicity and degree	(systematic) random; (exhaustive) selective
Interaction criteria	authority, importance, (topic)
Obstacles	lack of information, appropriateness, resources

Table 7.6: Characteristic information interactions: intensive customers

to the well established and organised social world, they have established themselves successfully within the existing information infrastructures and have been able to establish entirely new infrastructures for their disposal. The intensive customers use authoritative sources and they know which sources are authoritative. The knowledge state of an intensive customer is negotiating distinctly little with the outer world. The intensive customers are likely to benefit most of the subterranean flow of information [767], because they usually get the relevant information in time with only little extra clutter.

The level of self-efficacy in the group is high. The intensive customers know they will get the information. The membership of the group coincides generally with a relatively high level of education and a long professional experience. The systematicity and degree of activity in the group is basically systematic and exhaustive, but due to the practical reasons it tends to become both random and selective. The information 'seeking' is directed. The intensive customer prioritises relevant and 'good' information. Exhaustive searches are not of interest, because the information essentially comes to the intensive customer, not the other way around. The typical foraging strategies for an intensive customer are indexing, berrypicking and handling (ref. O'Connor et al.[561, 126-135]).

7.3.2 Affordances and constraints of information behaviour

The layout and characteristics of the information behavioural groups express clear coexistence with the work roles. Their relation is not, however, analogous. As with any issue of social life, the complexity of human information interactions negates the possibility of explicating a single factor, which would explain the information

Work role	Information behaviour
Field archaeology	Extensive (intensive) participants
Antiquarian	Intensive participants
Public dissemination	Extensive customers
Academic research	Intensive (extensive) participants
Academic teaching	Extensive customers
Cultural heritage administration	Intensive customers (administration subsystem)
Cultural heritage administration	Extensive participants (cultural heritage policy subsystem)
Infrastructural development	Extensive customers

Table 7.7: Work roles and information behaviours

behaviour and its emergence. It seems that an information behaviour is more inclined to be *guided* by a set of significant factors than to be *determined* by a factor or a set of factors.

The ecological approach (ref. Section 2.6.5) provides a starting point for understanding this phenomenon of 'guidance'. It is suggested that the formation of behavioural groups is first and foremost a construct, which shares some of the purposes, meanings and values of the work and work role. Following the ecological reasoning the guidance is a process, which incorporates a set of affordances and constraints. The ecology of an information behaviour does not set definite boundaries around the groups, but rather explains their, in a sense, spontaneous formation and the visible anomalies of the grouping around work roles.

The following sections discuss the factors, which affect the process of guidance and the principal affordances and constraints, which were identified during the course of the information work analysis to be affecting the information behaviours, and how the individual informants fit in to the information behavioural groups. The primary factors, which appeared to correspond with the grouping were 1) work roles, 2) whether the informant perceived herself primarily as an academic or a practitioner, 3) age and experience and the 4) contexts, situations, social conventions and individual 'habits' of the informants and their information work.

7.3.2.1 Work roles

The empirical material gives positive evidence on the significance of the notion of work roles in the explication of the formation of the information behaviour groups. The table 7.7 presents an overview of the distribution of the information interaction related information behaviours in conjunction with the seven work roles.

Field archaeology, antiquarian and academic research work roles fostered clearly a participatory information behaviour, while the public dissemination, academic teaching, cultural heritage administration and infrastructural development roles place an emphasis on the effective use and processing of the available resources. Extensity and intensity of interactions seems to be dependent mainly on the work role, and secondarily, on the purposes, meanings and values of the current work, which is performed within the frames of the role.

The principal work role, which is tendering the **extensive participatory information behaviour**, is field archaeology. Academic research is the other work role

where the extensive participation is somewhat typical. Extensiveness of the behaviour correlates clearly with the extense of the subject, which is under scrutiny. For instance, if an archaeological site is large and has been in use over extended periods of time, or a research topic is broad, the participation tends to become increasingly extensive. Also the the heritage administration role within its cultural heritage policy subsystem, is decidedly extensive and participatory. The policy makers need to grasp the wealth of available information to be able to formulate the working information in order to negotiate good practises, procedures and policy proposals.

The antiquarian work role has a principal association to the **intensive participant** behaviour. The information interactions of the antiquarians tend to be focussed intensively on the archaeological collection of the organisation, where the antiquarian works. Adjunct work roles, which occasionally involve intensive participation are the field archaeology and academic research. The roles fall into the behavioural category primarily when the activity becomes specially focussed, for instance, on a site, group of objects or theme.

Extensive customership is common in public dissemination, academic teaching and infrastructural development work roles. The roles differ considerably from each other when it comes to the information, its users, uses and characteristics. The behavioural process is, however, conspicuously similar. All work roles involve harvesting information from a broad range of sources and its distillation to another form in order to fulfil a particular purpose.

Being an **intensive customer** is characteristic to the cultural heritage administration work role within the scope of its administration subsystem. The work role comprises of information activity, which is typically very tightly focussed on individual issues, even though the entire scope of the activity attempts to manage the broader matter of cultural heritage in a regional, national or international context.

In spite of the possibility to make indicative conclusions of the convergence of the work roles and the information behaviour groups, there is some variation, which calls for a further discussion. The variations are discussed further in the following sections with a special emphasis on the possible factors relating to the organisational affiliation, age, experience and organisational and personal traditions and habits of the individuals.

7.3.2.2 Academics and practitioners

In the Nordic archaeology, the distinction between the pure academics and pure practitioners is notably vague (ref. [231, 219 Fig. 48] cf. [596]). The differences between the individuals, organisations, e.g. museums and university departments, and between the often consequential work profiles are usually more substantial than the differences between an archetypal academic and a practitioner. The relatively small number of archaeologists means that most of the 'academics' and 'practitioners' read the same journals, attend the same seminars and meet regularly discussing different practical and theoretical matters.

The integration of the practitioner and scholarly communities is largely explained by the relatively close connections between the universities and the national and regional archaeological institutions. Many of the interviewed professionals indicated that they were enrolled at an archaeology department as doctoral students or did otherwise maintain close contacts to the local department through personal communication and participation at various activities. The close personal contacts seem to foster a strong cohesion between the professional and scholarly

work roles and to contribute to the emergence and maintenance of shared notions of the purposes and meanings of the work and an extensive use of shared information sources. The double engagement as practitioners and academics is visible in the coalescence of work roles in the informants' work profiles. For example, one of the informants is a primary heritage board affiliate, who is engaged in cultural heritage administration and infrastructural development work roles. Besides her primary work roles, she is also involved in academic teaching. Several other informants, who work primarily in the field archaeology work role, also pursue an academic career and subsequently act in the academic research work role.

In spite of the shared information sources, the two approaches differ in other respects. The works, information works and worldviews diverge, as it seems, primarily according to the principal organisational affiliation. It was found out that the purpose and the premises of the explicit instances of information work might be categorised roughly to either professional, or scholarly categories, based on the explicit information behaviour of the individuals. Practitioners are usually more on the customer side while the academics, and to an extent the field archaeologists, are participants. Correspondingly, the scholarly information work tends to be more extensive in terms of information sources than the work of the practitioners. Compared to the practitioners, academics are also more bound to use chaining (i.e. discovering articles through citations and by being informed by the colleagues) and less inclined to turn to the formal information repositories or to consult the information professionals.

In archaeology, the information seeking bears resemblance to the other scholarly disciplines. Archaeologists discover literature in similar ways to the other scholars: through reading, browsing and searching literature, and chaining (e.g. [760][769]). The role of browsing collections and communicating with colleagues is of a proportionally greater significance to the archaeologists than the other methods. This emphasis is comparable to the observations of Talja and Maula on the humanities scholars' information activity [760]. The informants explicated that an important reason for this is the general scarcity of the published materials in Finnish and Swedish archaeology, and the subsequent possibility to stay informed without a need of resorting to searching in databases (cf. [760] on the researcher in Finnish history). Apparently for the same reason, the library OPACs are primarily used to locate books, which are already known to exist in the collection. The estimate that scientists use up to 50-60 percent of their time for communicating [767] is also well applicable to the academics in archaeology.

The principal difference between the information behaviours of the practitioners and the academics seems to concern formal assessments. The basic criterion of relevance and usability of a source is that it is produced by a professional archaeologist. Practitioners considered all available information, which is topical, as potentially relevant, while academics tended to put some conditions on the origins and the physical outlook of the information source. Practitioners seemed to rely more on personal communication and informal sources, while the academics were more inclined to prefer scholarly journals and monographs. The slight variation of behaviour is conveniently explained by the formal criteria of the produced information. Practitioners are working to produce descriptions, working reports and (to a degree) to summarise earlier information, while academics tend to emphasise argumentative interpretations. Also the strictly formal criteria of source use are typically enforced at a more rigorous level in academic communication than in the investigation reports.

If an information worker shares academic and practitioner work roles, it is obvious that her information work behaviour is necessarily affected by both of them. For example, an antiquarian, who has written her doctoral dissertation on a Viking Age topic, might, for instance, seek information on Viking Age food culture for a museum exhibition. While concentrating to find information for this particular purpose, the information seeking process is necessarily affected by her eventual scholarly interest in the same period and her earlier experiences on any possible source materials.

In summary, it seems clear that being a practitioner tends to (ecologically) afford customer-oriented behaviour even though there is some variation especially in the information provision oriented field archaeology and antiquarian work roles. Research and investigation on the other hand, seem to (ecologically) afford participation. Academics are usually participants in their research activity, but customers when it comes to teaching.

7.3.2.3 Age and experience

Besides the work role specific factors, the information behaviour is affected by several personal and social factors. The analysis of the interview record indicates that the intensity of both the participatory and customer-like behaviour relates significantly to the length of the personal experience in the field of archaeology. When an archaeologist becomes more experienced (i.e. secondarily: older), the personal and social bags of knowledge [495] tend to augment and their knowledge potential begins increasingly to substitute the need for a formal array of literary information sources and meta-sources. Seldén points out that the accumulation of this 'social capital' [110] is less dependent on the seniority than on the 'symbolic capital' [676, 205] (i.e. the amount of honour and prestige) possessed by the individual. In the light of the present study it seems, however, that the amount, and especially the relevance, of the social capital seems to be closely related to the length of the personal experience.[5]

As a consequence to the growth of the social and symbolic capital, the selection tends to confine itself to the constellation of known materials, and the materials explicitly suggested by someone. Generally the breadth of the consultation does also taper. Without any doubt, the picture is blurred by the recent emergence of an array of new electronic information sources and its effects on the information chain in both the user and provider ends [530][493]. It could be expected that the information behaviour of some of the now older archaeologists would resemble more that of their younger colleagues if the 'older' ones themselves had been exposed to the same 'new' resources during their studies and early professional career than the younger ones have. The information behaviour would thus be more inclined to change and adapt to the emergence of new opportunities and possibilities when the total amount of existing symbolic and social capital is still relatively small. This effect is difficult to study, because earlier, the horizon of information resources was far more stable and there were no corresponding rapid changes, which would have affected the entire landscape of information. In spite of this reservation, the findings do give sufficiently strong indication of the pertinence of the age and experience factor. The more experienced informants were clearly able to substitute the use of

[5] In Bourdieuan terms the accumulation of the personal experience increases the level of *cultural capital* [109] (i.e. knowledge and skills, which give a person higher status in the society). At the same time the need for a formal information sources tends to become substituted by the growth of *social capital*. [109][110] (i.e. resources based on membership, networks, social influence and support).

new alternative information sources by their experience and social networks. The pertinence of age and experience is further supported by the findings of Olaisen (for Olaisen ref. [496, 19-20, 49]).

In summary, it seems that the age and the experience constrain extensive behaviour. Younger and less experienced informants seemed to have been more inclined to be extensive in their behaviour than their older colleagues.

7.3.2.4 Contexts, situations, social conventions, and personal habits

The constancy of the social conventions, organisational and domain-specific preferences and the traditions and personal habits are a related notion to the age and experience. Bron et al. discuss the scholars' expectations of librarians and information services by referring to a brief set of interviews conducted at the Södertörn University College in Sweden. According to the study, the scholars expected to learn to become better information searchers, not long-term clients of information specialists [120, 24]. Previous experience in conducting research, increased the status of a librarian in the eyes of the researchers [120, 24]. Only two respondents appreciated and used a lot the service of the local library [120, 24-25] and the library use competence and computer literacy decreased the perceived importance of the librarians' service. In general, the researchers valued high the established system of individually assigned contact persons at the library they could rely on in their queries and requests [120, 25]. The tendencies reported by Bron et al. are also visible in the empirical material gathered for the present study. The present study also gave further indications of the significance of the respectively social and self-reliant information behaviours with respect to the use of library and information services. The social characters were more inclined to be representing an *intensive* information behaviour and being active in consulting the librarians and information specialists, while the self-reliant characters tended to be more extensive and correspondingly, less frequent clients of an information specialist.

The constituency of the social and personal contextual constructions has been widely acknowledged in the different fields of information science research [781] [780][586][705][708][707][706] (IRiX workshops e.g. [469]). Several informants expressed preferences of resorting to, for instance, only printed information sources, or of using some specific references and reference collections. These preferences were generally motivated by statements, which referred to the intrinsic authority and value of the information sources [S, V]. An information source is reliable, because it has an acknowledged position and esteem in the institutional and communal context of the individual.

All informants who were interviewed in their own offices or studies made direct references to their bookshelves, posters and maps hanging on the wall and the files in their computer during the interviews. The others described that they held a collection of salient monographs in a shelf next to their desk [A, C, H, M, P, R, S, T, V W]. The informants told that this personal reference library is consulted first in most instances of information seeking. The references provide a functioning starting point with previously less familiar subjects and may often provide a consolidating reference to the more familiar questions. The effectiveness of the personal reference shelf is based on its physical proximity and accessibility, the user's familiarity with its contents, and its coverage of the focal areas of its owner's information work. Besides being a practical tool for an effortless information access, the personal collection may also be considered as a 'solid' context for the information behaviour itself. The reason for using the own reference collection is not motivated

only by the preference of least effort (ref. [849]). It became rather apparent during the interviews that the bookshelf not only enabled information seeking and use, but directed the seeking towards covered themes, placed emphasis on the readily available matters, and even inhibited the permeability of information, which was not available in the collection.

The esteem of the distinct information sources is a socially perched construction. It functions as a strong communal carrier of authority, determinant of expected importance and even as an indication of a perceived accuracy. From the behavioural point of view, the appeal to the established information infrastructure intensifies clearly the activity. Theoretically even a relatively inexperienced individual might assume an intensive behaviour, for instance, in the academic research or in the field work, by confining herself and her personal information horizon to comprise a distinct set of socially and institutionally accepted resources.

7.3.3 Information behaviour in the making

The findings concerning the information behaviours of the informants of the present study show similarity with the earlier research results on the humanities scholars' information use e.g. by Brockman et al. [118] and by Lönnqvist [496]. Also several other studies of the human information behaviour in a variety of contexts, have revealed (in general terms) comparable traits and converging groupings of individual behaviours. It seems that the breadth versus depth and participation versus customer orientation are intrinsically typical to the human information interactions (e.g. in [361][572]).

The contextual differences make it difficult to operationalise the implications of these general patterns of behaviour. Due to the differences in the research frameworks, methods and questions, the results are not directly comparable. The important implication of the existence of rather pertaining similarities is, however, that the archaeologists are, broadly speaking, rather ordinary kind of users and contributors of information resources. Archaeology or archaeological work is not a factor, which would thoroughly affect the broad tendencies how people use and produce information in the different contexts of their everyday life.

The present analysis has indicated so far that the work role and its related information horizon, and the professional experience, are significant denominators of the general patterns of selecting and using information sources. The information behaviour appears to be independently specific to the work and its purposes, but also to the perceived values and meanings of the activities. It is directly related to the social and cultural context of the activities and to the individual preferences. The formation of the four information behavioural groups appears to be strongly related to the efficacy of the social contacts, the individual's conception of oneself and the individual's established position within the existing infrastructures.

The work roles provide a framework for the information behaviour. An equally strong determinant of the information behaviour is, however, the personal behaviour and the sphere of life of the individuals. The significant effects of the age, experience and the organisation of the social life-world give indication of the linkage of self-coherence, sense of mastering ones life, and of the information behaviour (ref. [250]). The respondents who gave a recognisable impression of a strong self-coherence in the context of their work, seemed to be also more confident and apparently more economic information workers. They were likely to use fewer, but more reliable and more useful sources, and they expressed a stronger efficiency in

their information work.

The information behaviour of the archaeologists resembles in its contextual dimensions a network of pathways across the field of archaeological information (cf. approaches to information behaviour studies in [418]). The information behaviour is clearly a trait, which is not static, but is constantly in the making within the scope of work and information work, and also outside of them in the personal sphere, which has to be taken into account when tackling with the human issues of information management.

7.4 Interactions with information

The present chapter has so far analysed and discussed the organisation of the archaeological information work within the framework of the work roles, and discussed the information behaviours of the individual informants. The purpose of the following sections is to discuss the work role and use case related information interactions (presented in Section 6) within the context of the system of archaeological information work. The discussion is structured according to the 'information behaviour' facet of the classification scheme of the information interactions (ref. Chapter 6). The earlier analysis identified nine types of interactions: *create, modify, organise, preserve, disseminate, access, evaluate, use* and *comprehend* in the use cases, which are related to the seven explicated work roles (*field archaeology*, *antiquarian*, *public dissemination*, *academic research*, *academic teaching*, *cultural heritage administration* and *infrastructural development*). The information on the individual and work role specific information interactions was collected during the discussion on the interview themes 2, 3 and 4.

The purpose of the following analytic discussion of the information interactions is to bridge the gap between the structural notion of work roles and the subjectivist information behaviours of the individual archaeologists, and to situate the diverse activities of the archaeological information work on the general life-cycle of information (ref. Section 2.3). This section explicates the classifications of the information interactions and discusses the determination of the different facets based, on one hand, on the human issues, and on the other, on the structure of the archaeological work represented by the work roles. A summary of the mappings between the interactions and work roles is shown in table 7.8.

7.4.1 Create[6]

Archaeologists create a diversity of information, which relates to past human activity and its spatial and temporal organisation. Information is created in the field during excavation and survey projects. The resulting documentation from the field projects is archived and subsequently used for various research purposes, cultural heritage policy decisions, public dissemination in articles and book, interactive presentations, documentaries and museum exhibitions, educational uses, and strategic planning of the forthcoming archaeological activities.

Associated work roles: *field archaeology*[7], public dissemination and *academic research.*

[6]For the information behaviour facet and its sub-facets ref. Section 6.1 and Table 6.2.

[7]The *emphasised* work roles reflect a pronounced association (ref. bolded work roles in table 7.8).

Work role	Create	Modify	Organise	Preserve	Disseminate	Access	Evaluate	Use	Comprehend
Field archaeology	**X**					**X**			
Antiquarian			x	**X**		x	x		
Public dissemination	x	x	x		**X**			x	x
Academic research	**X**				x			x	x
Academic teaching		x	x		**X**	x	x		
Cultural heritage administration			x	x	x	x	**X**		
Infrastructural development						x		**X**	

Table 7.8: Cross-tabulation of the work roles and information interactions classified according to the 'information behaviour' facet. The foci of the interactions related to each work role are indicated by using a bold typeface and versal letters.

Method: Archaeological information is created by *documentation* and *argumentation*. Basically all information created by the archaeologists is based on argumentation, because also the first-hand observations on the sites and materials represent a viewpoint of the documenting archaeologist, not a true 'replica' of the original situation. This documentation may be considered, however, as a special type of argumentation, which aims to produce a relatively value-free and universal instance of information, which represents the essentials of a single entity of information (the site). The argument is built in the document, but the document is formulated as if the argument would be already a consensus.

Contrary to the documentation, the further use of the reports and documents represent a deliberate attempt to reach beyond the original observations and present interpretations based on the active scholarly reasoning. According to the informants, the fundamental basis of argumentation is the primary material and first-hand observations of archaeological sites and objects. Secondary sources are used to complement the first-hand corpus of evidence, and to explicate the areas of interest, which are not covered by the first-hand information.

Mode: Archaeological information is created on 'top' of existing knowledge. Human beings do not reside in a vacuum, which implies that no piece of information can be thoroughly isolated from all previous experiences of an individual. In archaeology, as in the scholarly contexts in general, the information is expected to be verifiable (i.e. a new proposition is expected to be grounded by a reference to the preceding information). The process of creating new is variably based on the recognition, comparison, interpolation, combination and contextualisation of different pieces of earlier information. A typical starting point in the field archaeology and academic research is the archaeological material, which is complemented with secondary sources such as historical documents, earlier scholarly studies and ar-

chaeological documentation, and other appropriate material. The planning of the projects, administrative tasks and educational activities does, on the other hand, typically start from the general and secondary information, which is subsequently complemented with primary information, when necessary.

Level: Information creation in archaeology consists primarily of *processing information with meta-information*. The significance of the individual pieces of information is likely to vary between the different instances of information work. Information functions as information and as meta-information in different contexts depending on its use and users. Field archaeologists and academic researchers use mainly primary archaeological material as information. The published studies and reports do, on the other hand, work in these work roles as descriptive and indicative meta-information. In contrast, the other work roles tend to refer to the secondary material as information, often omitting most of the direct references to the primary materials.

Systematicity and degree: The conflicting notions of exhaustivity and systematicity in principle, and of the sampling and randomness in the practise of the documentation and information work process, is also reflected in the creation of information. Field and research documentation is expected to cover exhaustively and systematically all observations with a discretionary filtering of insignificant noise, which is made by the professional archaeologist who is in charge of the project. In the secondary stages, the information creation process is typically based on a certain systematic idea. A museum educator may be willing to create a special workshop for children on medieval clothing. A cultural heritage administrator may, on the other hand, need to compile a report of all archaeologically interesting sites on a given area in order to decide on the conditions for the proceeding of an exploit. In contrast to the framework given by the idea, the information creation process is a procedure, which involves randomness and selection. The educator is likely to check all available (a random and selective notion) information on clothing, which is suitable for the children and for the premises of the workshop (selective). Similarly the administrator needs to make practical decisions on the depth and extent of the investigation, which is conducted to produce the report.

Interaction criteria: In archaeology, any information creation is based on the explicit premises of authority and the plausibility of the interpretations. Information needs to fulfil the (relative) criterion of truthfulness. Besides the notions of systematicity and exhaustiveness, especially the secondary level information creation is steered, on the one hand, by the notion of representativeness and on the other, by the unusuality. Usuality is a good indication of the typical state of affairs, which interests archaeology professionals, who are typically seeking to understand the general patterns of past human life. Unusuality is, on the other hand, an indication of potentially new or earlier unknown information, which deserves to be brought to the public attention.

Obstacles: Due to the difficulties of accessing systematically the earlier data, the representativeness and unusuality remain basically intuitive and experience-based judgements of the information creators. The 'ideal' information creation process is hindered by the lack of contexts also on the level of establishing a general background. Material remains of past human activities are useful for discerning various patterns of activity, but typically less informative on the mental world of the peoples.

Appropriateness hinders information creation in the context of the expected needs of the users of the created corpus of information. If lacking the contextual

information, some archaeological objects are possible to describe only on a level, which is not appropriate for the public communication.

7.4.2 Modify

Modification of information is not an explicit part of the earlier described archaeological information work process. Archaeology assumes that information is gathered, preserved and used unmodified. Despite the paradigmatic refusal to directly modify archaeological data, the information becomes altered in the process of creating descriptions of the objects and using new information to complement, precise and correct old interpretations and emphases. The alteration is clearly visible, for instance, when a university course in archaeology is created or updated (academic teaching), and when a scholarly publication is modified (or edited) to a popular document (public dissemination).

Associated work roles: public dissemination and academic teaching.

Method: Modifications involve working with media objects by writing, drawing, filming and taking photographs anew. Production of a popular book on an archaeological subject consists of writing the text on the basis of appropriate scholarly texts, choosing and possibly taking photographs and drawing necessary illustrations. Besides the basic productive and reproductive activity, the modification also requires reorganisation of the existing material with an intention to form new entities and connections of information. Editing a new version of a book or a lecture series, typically builds on the existing corpus of material, which may be both reorganised and replaced depending on the current needs.

Mode: The act of modification is based on the notions of changing the actual information by contextualisation and classification of the primary data and by updating and replacing obsolete interpretations with newer, more informed and plausible ones.

Level: Modifications are considered to be information level actions. In the context of the present investigation, the modifications of the meta-information artefacts are assumed to belong to the use cases of organisation and preservation. The act of altering metadata is considered to be subordinate to the primary purposes of ensuring preservation and organising information.

Systematicity and degree: Production of secondary accounts on archaeological subjects foresees that a systematic selective approach acts as a scope of the modifications. A popular presentation looses its meaning if it attempts to be a systematic overview of all archaeological data on a subject. The selection of a sample requires systematicity to retain its authoritativeness and relevance in the scope of the final information product (e.g. a book or a television documentary). In a case of modifying an existing version of information to a new one of precisely the same level, the process of modification may be exhaustive. Its scope is, however, still characterisable as selective.

Interaction criteria: The eventual modifications are typically motivated by different changes in the authority of the information, by the topic and its importance, and by the interest in its context. Archaeological field work reveals constantly new evidence, which may either support or erode the authority of the earlier interpretations [M]. Topic, importance and interest affects the dynamics of the modifications. Technical topics, such as the chemical composition of ceramics, are of a significant scholarly interest, but might be a subject of a modest popular interest. One further criterion mentioned by the informants was the functionality of the information in

a context. If the purpose of a course is to instruct archaeology students on the archaeology of a specific period, a functional approach is to emphasise the typical and distinctive features of that particular period instead of concentrating on the possibly uncertain exceptions.

Obstacles: The principal obstacles of the modification interactions relate to target audiences, their preliminary knowledge, training, and the appropriateness of new information for the dissemination in the context of these particular groups. Training and the resources, which are available to the modifier, constrain the scope and content of the changes, as well as the obstacles of time, access and an eventual overflow of information pose restraints.

7.4.3 Organise

Archaeological information work comprises organising in various contexts and on several different levels. Registering new finds after their discovery (field archaeology, antiquarian), creating secondary level archaeological publications, which confront the past with the present (public dissemination), preparing archaeology courses (academic teaching), and formulating archaeological heritage policies (cultural heritage administration) are instances of organising information. The distinctive characteristic feature of the organisation interactions compared to the creation ones, is their focal emphasis on reordering instead on adaptation or reproduction.

Associated work roles: antiquarian, public dissemination, academic teaching and cultural heritage administration.

Method: The organisation of information is based on a comparison of materials, which is followed by merging, rewriting, structuring and restructuring. Information is confronted with already organised information. New finds are compared to the finds stored in the repositories, information about the past is set against the contemporary events, prospective course contents are contrasted with overview articles and monographs published on the topic, and the available information on the importance and value of the archaeological sites is set against the community development needs. The method of organisation may refer to formal classifications and guidelines, or become warranted on the basis of an educated expert judgement made by the organising person.

Mode: Information organisation is based on attachments, contextualisation, summarisation, simplification and compilation. *Attaching* is used to denote the interactions, which provide relational links between existing entities (organising finds according to their expected date or identifying the relations between several archaeological sites based on the similarity of the finds). *Contextualisation* is required as a prerequisite of attaching. The contextualisation may provide, for instance, explanatory and situation concerned information, technical (such as references to the relevant stratigraphic contexts in the excavation documentation) and descriptive data (such as in the case of the secondary level publications). *Summarisation*, *simplification* and *compilation* are necessary to instantiate the organisation and make it comprehensible and practicable for its users (cf. e.g. a report, which is a compiled and simplified summary based on the contents of a database).

Level: The organisation interactions presume work with information level objects (e.g. the finds), and creation, revision and use of related meta-information (e.g. provision and use of database descriptions) in order to realise the organisation in practise. The organisation activity concerns *per se* with information. Meta-information is, on the other hand, used as a instrument for completing the particu-

lar task of organising information.

Systematicity and degree: The systematicity and exhaustivity of organisation may vary depending on its expected use. Registering finds is a task, which requires systematic and exhaustive organisation of all available data. The creation of secondary level information, like confronting the past with the present, involves a degree of randomness and selection based on the currently actual issues in the society, because the evolution of these themes are basically out of the archaeologists' control. Course design necessitates an exhaustive selection of relevant and topical materials, even though the exhaustivity is often a relative notion in the pressure of the perceived feasibility and the economy of the work. Information organisation, which is needed for an informed policy formulation and policy decisions, requires systematicity and exhaustivity within the confines of the available information.

Interaction criteria: Organisation interactions are closely interlocked with the notion of authority. Documentation and cataloguing is expected to be authoritative through accuracy and exhaustivity. The secondary level organisation work (i.e. after the creation of initial organisation) relies on the first level accuracy in the esteems of importance, authority, topicality and attractiveness i.e. the perceived importance in the public sphere.

Obstacles: Basically all organisation interactions are concerned with relatively similar obstacles. The hindrances comprise the lack of resources, information overflow, impossibility to have comprehensive training in everything, lacking appropriateness of the information available for organisation, and the limited time available for the organisation work.

7.4.4 Preserve

Preservation is related to the most of the archaeological information intensive interactions. Preservation is nevertheless one of the constituent functions of the cultural heritage work besides the acquisition of information, research and communication. In spite of its prevalence, the preservation is, however, the primary concern in only two work roles. They are the antiquarian (maintenance of archaeological collections) and cultural heritage administration (management of cultural heritage assets) roles.

Associated work roles: *antiquarian* and cultural heritage administration.

Method: The principal method of the cultural heritage assets preservation is the management of the known assets in collections and *in situ* in the environment. The management is based on a careful monitoring, upkeeping and optimisation of physical conditions, prevention of further damages, policy formulation and conservation. From the information point of view, the management is focussed on the administration of information on the assets and on the development of the best practises and methods of administering that information.

Mode: The primary purpose of the preservation work is to keep the existing assets in as good condition as possible. The usability of the assets is another important dimension of the cultural heritage management, but in spite of the negative notion that 'cultural heritage does not exist if it is unavailable', the preservation is more important. It ensures that the assets survive for the coming generations and for the sophisticated research methods of the future.

Level: The preservation work is based on both meta-information and information. Meta-information often functions as a primary tool for the surveying the state of collections and as a basis for the policy decisions and planning. The actual sub-

ject of the preservation interactions is, however, the information i.e. an object, a site or a landscape.

Systematicity and degree: The preservation interactions are basically systematic and exhaustive, because the purpose of the activity is to secure the conservation of entire collections, sites and landscapes. Selection is done before conservation. In only relatively unusual conditions, the assets may be removed from the preservation. Possible motivations for the removal might be a complete destruction of an asset in an accident, radical changes in the valuation of the cultural heritage, cogent needs of land use and unveiling of a forgery. Selection and randomness are used, in the sense of sampling, to economise in the monitoring and inspection of the collections.

Interaction criteria: The preservation work itself, is based on the notions of accuracy and exhaustivity like the discussion on the systematicity and degree of the interaction suggests. The individual interactions do follow the principle, although the use of sampling is necessary to make the preservation effort feasible (ref. the systematicity and degree above).

Obstacles: The most imminent obstacles of an effective preservation consist of the lack of resources and of the overwhelming amount of materials and assets requiring preservation. The both issues are addressed by resorting to sampling in order to attain a satisfactory level of exhaustivity. It is obvious that the obstacles do remain in spite of the efforts because of the overflow of the materials.

7.4.5 Disseminate

Dissemination is one of the most typical interactions, which relate to the archaeological work. Archaeologists disseminate information in a variety of manners, for various audiences and using a variety of media. Cultural heritage administrators disseminate information to the actors, to the public and private exploiters, policymakers, practitioners and influentials in the form of policies, guidelines and opinions. Academic teachers disseminate information to the students in the form of supervision and courses. To the public, the information is disseminated, for instance, in the form of exhibitions and books, but also in a variety of complementary manners including the popular articles, lectures and free discussions. The criteria, manners and outcome of the interactions depend considerably on the audience. While the notions of importance and authority of a given piece of evidence remains archaeologically the same, the notion of how they are communicated, is contextual and situated.

Associated work roles: *public dissemination*, academic research, *academic teaching* and cultural heritage administration.

Method: Archaeologists disseminate through publishing and communicating by using a variety of media. The national heritage authorities publish books, guides and leaflets on topical subjects in order to disseminate best practises, to highlight and publicise current policies and to promote the national cultural heritage. A large part of the everyday dissemination activity is handled through a targeted correspondence with the exploiters, government, local officials, and the representants of the general public. The individual archaeologists and the employees of museums and university departments disseminate information by publishing books and articles, and by organising guided tours, lectures and presentations. The role of a strictly confined personal dissemination (i.e. correspondence) is important within the professional and academic communities, which unite archaeologists who work

in similar kinds of duties and with coinciding themes.

Mode: The essential objective of the dissemination is to inform and instruct colleagues, students and the general public about the archaeological heritage and especially to contextualise one's own findings in the general debate about the human past, cultural heritage and its value in the society. A mode, which received a special emphasis in the interviews, is the one of 'making available'. The informants emphasised the necessity of disseminating information and information about the existence of information. The media of communication varied according to the audience. Most of the scholarly communication is written and based on the use of photographs and drawings, while the general public tends to be approached by using narratives, illustrations, photographs, exhibitions and models.

Level: The dissemination of the archaeological information consists mostly of the dissemination of information level entities. Teachers and tutors do point their adepts to the meta-information. Similarly, the mode of 'making information available' represents an instance of disseminating meta-information. In most of the duties, the communication is centred on the archaeology and the past, not on the communication of how to find out something about the archaeology.

Systematicity and degree: In the policy matters, the dissemination varies from a systematic and exhaustive to the various degrees of selectivity and randomness, when it comes to the dissemination of information about the past itself. The dissemination about broader questions such as "how the people lived during the Viking Age", typically results in a more selective and even random choosing of the information. Simultaneously, the communication about an individual artefact or a site, may be relatively exhaustive and systematic.

Interaction criteria: The Dissemination is based on the notions of authority, accuracy, importance or topicality, the context, and in the public communication, typically also on the outlook and attractiveness of the subject. The authoritativeness, importance and topicality are highly context dependent notions. The importance of a piece of information has to be explained for an exploiter in a practical manner, while the general public tends to be more concerned about the experienced societal and personal importance of the archaeology and the past.

Obstacles: The principal obstacles for disseminating information on archaeology comprise resource problems, lacking of a relevant, or an overflow of a possibly relevant information, problematic access and of appropriateness issues. Policy formulation is often constrained by the lack of information on coming exploits, by strict schedules after the information becomes available, by the lack of available information on the sites or areas, and by an overflow of potentially relevant information sources, which are available in low-accessibility formats (e.g. in several physically distant archives, libraries and museum collections).

The public dissemination is partly constrained by the lack of certainty and comprehensiveness of interpretations. An excavation typically produces a considerable amount of technical data, which tends to be rather tacit, when it comes to the presenting of a comprehensive view of the site and its users. The exhibition design is restricted by the availability and appropriateness of finds, which would be capable of illuminating the desired aspects of past human activities. The very typical constraints of lacking time and occasional lack of training (from the part of the interpreting researchers, disseminators and the audience), also apply to the dissemination.

7.4.6 Access

Archaeological work involves two basic kinds of access type interactions. Archaeologists access primary archaeological material, and secondary material (*information* or *meta-information* depending on the context of use), which describes and contextualises the primary sources either directly or indirectly. The both kinds of information sources are used for many distinct purposes in the different work roles. The archaeological primary material may be, for instance, accessed to judge the importance of an archaeological site, to retrieve material for an academic research assignment and to find out appropriate artefacts for a museum exhibition.

Associated work roles: *field archaeology*, antiquarian, academic teaching, cultural heritage administration and infrastructural development.

Method: The access interactions comprise investigating (i.e. making sense[8]) the information, which is presumed to exist, scanning for the possible availability of a piece of information and searching for a presumably existing information with an intention of further retrieval and use. As a special case, the present study also considers the acts of surveying and excavating as instances of accessing information that is stored in an archaeological stratum or in the environment in the form of archaeological remains.

Mode: The applicable modes include specification in the sense of an operation to process specific objects, and scanning in the sense of retrieving information on the availability of objects.

Level: The primary material is normally accessed at the level of *information.* Archaeological objects are used sometimes as meta-information, for instance in the case of analysing their chemical and physical consistency [U]. The secondary sources are used in a variable manner as information and meta-information, depending on the aims of the access interaction. For instance, a fieldwork report functions as a *meta-information source* on the examined site, but as *information source* on the reporting conventions used by a particular field director.

Systematicity and degree: Theoretically the access is an exhaustive and systematic operation both at a site of excavation and off site. For instance, for the purposes of teaching, public dissemination and research are expected to demonstrate a degree of systematicity and exhaustivity. In practise, all operations involve either implicit or explicit sampling. *Explicit sampling* is a conscious choice motivated by a judgement of feasibility, relevance and economy of work. *Implicit sampling* is typically a result of inadequate means to reach an exhaustive coverage. In fieldwork, the archaeologists examine theoretically all objects present in the investigated stratum, perform necessary relevance judgements and finally decide whether something should be documented in detail and preserved. However, it is basically impossible to recognise and recover every single artefact, because of their large quantity and variety. Similarly, due to the technical reasons, the retrieval of each tiny object and the documentation of every small detail, is often impossible (ref. [45]). The precision of the resulting pragmatical 'sampling-in-practise', may be controlled by choosing an appropriate excavation method. The precision of the sampling may be increased by choosing a shovel or a trowel instead of using an excavator, by changing the resolution of a sieve, or by instructing a trained archaeologist to excavate with more or less meticulous precision [D].

The secondary material is sampled explicitly and implicitly. Limited search facilities, and the occasional unavailability and limitations of reference materials *cause*

[8] In colloquial meaning of the concept (cf. the Sense-Making Methodology).

a degree of voluntary and involuntary sampling. Among the informants, especially the archaeology professionals (in contrast to the academia), indicated a strong reluctance to seek information beyond their own department and the nearest library. The interviewees indicated that the primary reasons to restrict the searching are the perceived comprehensiveness of the local information resources, and the lack of time and resources to proceed any further.

Interaction criteria: The basic criteria of the archaeological access interactions are based on the notion of adequateness and representativity, authority, accuracy, importance, potential and exhaustivity. All of the search tasks are expected to fulfil the criteria of *accuracy* and *exhaustivity*, which tend to become, however, compromised for practical reasons. When a cultural heritage administrator inspects an area of proposed exploits, she is expected to conduct an exhaustive analysis. The exhaustivity and accuracy of the examination have to be adapted, however, to the context and situation of the assessment. A thorough inspection of a remote site is often beyond the practical limits of the cultural heritage administration authorities. Also the accuracy of the fieldwork may be compromised by, for instance, bad weather conditions, which do not allow as meticulous precision as would be desirable. Similar limitations may be caused by the lack of time and the availability of the adequate material resources. The authority, and the subsequent usability, of the results may be compromised by the inferior quality or the lack of available information. Typical examples of 'inadequate' information are hasty reports on quickly inspected sites, interpretations, which have been based on unoptimally preserved materials, and reports on early non-scientific excavations of archaeological sites.

Obstacles: The most typical problem of accessing archaeological information relates to the lack of time and resources, combined with the abundance of the potentially relevant resources and the scarcity of reliably relevant information. Generally speaking, the archaeologists are always suffering of the scarcity of relevant information for their actual problems and questions. The total quantity of the available information depends heavily on the period, which is under scrutiny. The typical prevalent problem in the pre-historical archaeology is the complete lack of study material, while for the historical periods, the problem relates to the number of informative sources. The issue of quantity is related to the organisation of information in the heterogeneous and geographically distributed collections, catalogues, reports and databases. Exhaustive access often requires exhaustive manual labour.

7.4.7 Evaluate

Evaluation interactions may be uncovered throughout the archaeological information process. They serve in directing and altering the process according to the current contexts and situations. Besides the general evaluative thrive, it is possible to point out a number of instances where the role of evaluation is of a central importance. The archaeological information work involves evaluation of both the primary archaeological assets (e.g. sites and finds) and the secondary information sources. The evaluation serves in an important role in maintaining the scholarly coherence of the archaeological discipline, and the social integrity of the community of archaeologists.

The foundations of the archaeological evaluations are laid out in the field work when an area is surveyed or excavated, and the features, finds and structures are documented and registered. The registering and documentation (i.e. *accessing*) the buried and excavated information, is steered by the general expectation to report

everything that is 'relevant' and 'important' in the site and excavation process. The evaluation of the retrieved information is most salient in the work of the archaeologists who are acting in the antiquarian and cultural heritage administration work roles, even though a chain of implicit evaluation (in the form of the criteria of information interactions) spans through the entire archaeological information process from the fieldwork to to the academic research and dissemination of the information. The perceived overall importance and the need of protection of the individual finds and sites, is largely determined on the basis of the original considerations and remarks made by the field researchers. Policy decisions and opinions may be preceded by a brief inspection in situ, but typically, the original statement of the archaeologist who investigated the site in the first place, is of the primary importance.

The evaluation is also a part of the academic teaching. Students are evaluated by their teachers during the classroom sessions and especially during the personal supervision and tutoring. The evaluations, which are conducted by the teachers, affect the judgements of the students' formal qualifications, but do also guide the process of tutoring, and the contents, and occasionally, the methods of instruction.

Associated work roles: field archaeology, antiquarian, academic teaching and *cultural heritage administration*.

Method: Evaluations are based on the cross-checking of references and conforming of the corpus of the material with established guidelines and earlier pieces of evidence. The choice of research methods and the perceived importance of individual archaeological features and finds depend considerably on the earlier experiences of the investigating archaeologist. The overall importance of a site is determined on a similarly comparative basis in an evaluation, in which the site is contrasted with comparable, already known sites.

Mode: The mode of the evaluative reference studies is based on the recognition of the 'important' features and their evaluation in a relation to the bulk of the material. Unlike the evaluations of the archaeological assets, which are based on quantitative and qualitative observations, the quality of archaeological documentation or the professional skills of the individuals, may be compared to pre-established formal guidelines, such as the national documentation standards of archaeological field reports (archaeological documentation) and course descriptions in a curriculum (professional skills).

Level: The different evaluative activities are based on varying levels of information. The field evaluations are based largely on comparing the emerging information with the collective experiences, earlier knowledge, and the awareness of the work group on the existence of comparable information. Cultural heritage administrators rely primarily on meta-information in their work. In the academic teaching work role the supervision and tutoring related evaluations do, on the other hand, typically function on the level of information. As a further example, a teacher is in a direct contact with her students, and is therefore able to benefit of a first hand observation (i.e. of information).

Systematicity and degree: The systematicity and degree of the evaluations depend considerably on the available resources and obstacles that are present. The paradox of randomness and systematicity, which is characteristic to the archaeological field work, also applies to the fundaments of the evaluations. Cultural heritage administrators are more tightly bound by the availability of the resources, which makes the evaluation more systematic within the practical confines of the available information. An evaluation of a student may be a relatively systematic and exhaus-

tive process, but it is still dependent on the subjective judgements, selections and systematicity of the tutor.

Interaction criteria: All of the evaluations are expected to be accurate and to be based on the notions of authoritativeness, importance and topicality. The various criteria become, however, quite easily compromised by the practical obstacles of the information work. The importance of the information is relative to the other criteria (authoritativeness and topicality) and it seems that the two tend to compensate or strengthen each other. If the perceived importance of the information is low, the requirements on its authority tend to be simultaneously lower. The topicality of the information is determined by the objectives of the evaluation. The authority, on the other hand, tends to be an amalgam of meeting the criteria, the reputability of the evaluator, and the plausibility of the evaluation.

Obstacles: Time is typically one of the most critical obstacles of a proper evaluation in the archaeological field work and in submitting opinions on the administrative work. Other typical hindrances are the general lack of resources, overflow of information, lack of special training related to some individual details, and the lack of appropriate information to make educated decisions.

7.4.8 Use

Within the scope of the various information interactions, the instances of use are usually the most complex ones. The complexity is reflected in the heterogeneity of individual cases, but also in their relatively low number. The information use may be perceived as a transition, where the information is used to affect an external entity (from the information point of view) such as the physical world or a human actor, including her emotional and affective processes of cognition.

The interaction of providing a museum visitor (or in a general sense a 'consumer of cultural heritage') an affective sensation based on the archaeological information conforms to the definition of information use. The purpose and meaning of the interaction is not to disseminate information, but to make the user to sense the implications of the information in her cultural context.

The archaeological academic research (the case of finding information about an artefact, ref. Fig. 6.9) and interpretation represent another example of the information use. The interaction relates to a complex process of emerging 'new information' based on an existing information resource. Even though the actual novelty of any individual instance of information is always somewhat debatable, the use interaction is distinguished from the organisation in the aspect that the presented information bears a novelty value within its context of emergence. The distinction of use from the information creation interaction faces comparable difficulties than distinguishing creation and organisation. The focus of the use is practically definable by an emphasis on the attempt to make use of the archaeological objects, instead of fastening to the primary purpose of creating new information.

Besides the public dissemination and academic research, the third instance of information use, which was identified during the current study, relates to the infrastructural development and application of new methods and techniques. Basically the interaction resembles closely the archaeological research. Both are based on the notion of actively emerging new information. The primary distinction is that the infrastructural development concentrates on the technical information and uses it to breed new practical and theoretical methods and techniques for the archaeological research, and for the management of the archaeological heritage.

Associated work roles: public dissemination, academic research and *infrastructural development*.

Method: The primary methods of evoking new information and knowledge in the archaeological contexts are interpretation, comparison, and the application of earlier knowledge in its related domains and contexts. The interpretation and application typically reside on the multiple levels of cognition, and do involve diverse methods of knowledge formation, which include logical induction and deduction, hermeneutics and heuristics. The eventual diversity of the objectives makes the interpretation a complex and heterogeneous process. The situatedness of the interpretations underlines the necessity of considering the modes and the criteria of interaction with a special focus on the reaching the essential outcomes of the interaction.

Mode: The modes of the interaction are dependent on the objectives of the information use. The prevalent perception of the meaning of the archaeological information and knowledge among the informants relates the affective information use to the societal and individual notions of identity construction. The identity construction instantiates through narratives, contextualising the present with the past and through relating past activities to the life and experiences of the present users.

The prevailing mode of information use of the archaeological research concerns the contextualisation of the individual finds within the scope of the related finds and information available in applicable complementary sources. The finds and structures may be contextualised by using comparable material from related sites, by consulting the literature or by acquiring the necessary contextual information in a personal communication with colleagues.

The infrastructural development focusses on the mode of adaptation. The technological and scholarly techniques are adapted to the contextual and situational framework of the interaction. The information use emerges from the reasoning of how e.g. geospatial measuring techniques and equipment could be used on an archaeological excavation.

Level: The information use interactions concern mostly entities of information level. The information use, which is related to research, necessitates occasional references to meta-information, for instance, in the case of referring to the secondary literature in order to contextualise the primary information.

Systematicity and degree: The systematicity and exhaustiveness of the use interactions are typically dependent on the available resources and the perceived importance of the topic. The popular presentations are generally based on a rather limited systematicity and selectivity. The archaeological research is expected to be more rigorous in the sense of systematicity and selection, yet especially in the field project conditions, the possibilities to conduct very systematic and exhaustive documentation is often constrained by various practical troubles such as bad weather conditions, or a lack of time and resources. Contrary to the emphatically *archaeological* work, in the infrastructural development, the information use may be guided by relatively random ideas even if the development process itself would be controlled more rigorously.

Interaction criteria: The principal criteria of information use consist of the *appropriateness* of information (for "emerging affects", "finding out information on archaeological artefacts" and for "applying methods and techniques", ref. Figs. 6.7, 6.5 and 6.15). In the research contexts, appropriateness is also related to the notion of 'knowledge potential', which is consequentially related to the archaeological emphasis of the representativeness on one hand, and of the unusuality on the other.

The infrastructural uses are primarily motivated by the fit of the discussed topic, applicability of the proposed technique, and to a degree, by the authority of the person or institution, who suggests the technique.

Obstacles: The use of information for emerging affects is typically constrained by the appropriateness of available resources for the construction and maintenance of identities. The artefact, site, structure and feature analyses are constrained by the limits of the specialist training in specific analytical subjects (such as osteological or archaeobotanic analyses) and the lack of information concerning related phenomena. The resource problems, organisational resistance to change and the limited access to the appropriate information resources constrains the infrastructural development use of information. The new technologies tend to be expensive and their effective adaption requires special training beyond the archaeological education and often implies major changes in the familiar work processes. The information on the novel techniques and methods might also be scarcely available.

7.4.9 Comprehend

Comprehension is an information interaction, which relates to all intellectual work. Both the scholarly research and the public reception of the archaeological information are dependent on a successful comprehension. Unlike the 'use', the comprehension is perceived principally as a cognitive activity, which is based on the notion of a cognised reception of the explicit information.

The comprehension interactions, which were identified in the empirical study, include a use case of communication with an information seeker who belongs to the general public, and the scholarly activity of seeking information on archaeological assets in order to increase the present understanding of past human activities. The comprehension interactions emerge both congruently with the interaction of accessing information and as latent processes, which need not to be directly consequential with the acquisition of information and the formation of knowledge. The division is rather artificial as both the scholars and the general public engage in the both levels of comprehension. Besides, also the first-hand comprehension is, on a fundamental level, founded on the personal context of an individual. The distinction serves here, however, a purpose of distinguishing the cognised dimensions of comprehension. According to the empirical material, it seems to be feasible to underline the purposeful nature of the contextual interpretative comprehension of the scholars, and the more typically accidental and occasional archaeological heritage related comprehension of the general public. An important aspect of the latter kind of comprehension is entertainment, which complements the occasional formal interests to the information.

Associated work roles: public dissemination and academic research.

Method: Access-related comprehension functions through reading, listening, seeing, and purposeful observation. A museum visitor engages in the comprehension interaction through accessing (i.e. visiting) a museum. The contextual and situated scholarly comprehension is on the other hand, an interpretative rather than focussed activity at the moment of a direct observation. The comprehension is an act of interpreting new information on the basis of an accumulated information base.

Mode: All interactions of comprehension involve explicit or implicit contextualisation of information with earlier evidence and experiences. The act of recognition, for example, in the sense of 'comprehending' an artefact in the light of personal ex-

periences, is an instance of a surface level contextualisation. The purpose of recognition is often the naming of an artefact and subsequently the linking of it to the earlier knowledge. Contextualisation on the other hand, may be denoted as a more thorough process of establishing a network of more dense and more precise links.

Level: The level of information referred to in the act of comprehension involve a tight interplay of information and meta-information. The principal objects of information (i.e. information) such as the artefacts, popular displays and other pieces of evidence on past human activity, are contextualised by comparing them to the available meta-information and information.

Systematicity and degree: The systematicity and degree of the comprehension is a volatile matter. In the sense of entertainment, the access may be random and selective, because of a motivation, which is secondary to the archaeological context. Systematicity and exhaustivity are of a considerably higher interest in the scholarly research. Systematicity is especially central in the study of the primary materials, because all estimations of their particularity and unusuality are based on a systematic mastery of the evidence. The broader, culture centric studies may function with greater 'randomness' and with a selection based on the topicality and appropriateness judgements.

Interaction criteria: The criteria of interacting with the archaeological material depend on the eventual use of the information. Public displays tend to emphasise authoritative and as undisputed information as possible, but are also inclined to consider the estimated attractiveness of the subject matter to the general public. Peculiarities and various presently actual phenomena, which have direct parallels in the past, are covered more frequently than subjects with no direct interface with the present. The scholarly work is concerned with the notions of authority, potential of emerging meaningful information (especially in the artefact studies), and respectively, the representativeness and unusuality.

Obstacles: The comprehension of archaeological information is always bound to be hindered by the occasional lack of specialist training, which is needed in the work with a particular set of material. The scholarly work is restricted by the lack of resources to conduct a proper study, by the difficulties of access due to the distances between the archaeological collections, and by the difficulties of obtaining permits to study certain materials, the lack of relevant information and the lack of context. The lack of context becomes a crucial factor especially with the old archaeological collections gathered prior to the 20th century, when the contexts, precise find locations and other complementary information was considered to be of no interest.

7.4.10 Summing up

The purpose of this discussion on the information interactions was to bridge the gap between the respective effects that the organisation of work (ref. work roles, Section 6) and the personal behaviour (ref. information behaviour groups, Section 7.3.1) have on the human information activity. The concurrent themes, which appear in basically all interactions are:

1. **The constituency of the situatedness and contextuality of information:** Archaeological information is largely cumulative. All archaeological information work is founded on the context and situation of its emergence. A variety of information, including the knowledge of the existence or nonexistence of

earlier information, is needed to interpret and situate any new findings. Archaeological information is expected to be systematic and exhaustive within the context of interest, even though a thorough systematicity and exhaustivity are impossible to achieve in practise. The principal obstacles of the most of the interactions relates to the appropriateness, need and occasional lack of specialist training.

2. **The political nature of the archaeological knowledge:** All archaeological information are interpretations, and thus under debate. The observation on the pertinence of the evaluation interaction and the manner in which it derives from basically all other archaeological information interactions, is constituent. The resonance of archaeology and archaeological knowledge (discussed in Chapter 5) provides background to the complexity of the issue. It is essential to note that the policies are reflected both in the structures of the archaeological profession and in the behaviour of the individual archaeology professionals.

3. **The intricacy of the functioning and formation of the authority and trust relationships in the archaeological information work:** Authority makes a constituent criterion for the information interactions. Only seldom it is entirely surpassed by the exhaustivity. Even then the criteria tends to remain pertinent. Authority and trust are communicated in both formal and informal means.

The resonance of the three identified themes are in how they affect both the individual information behaviours and the structures and the organisation of the archaeological work. They function within the system of work as *warrants* of organisation and *affordances* and *constraints* of behaviour (ref. Section 3.1.6). The implications and the nature of the issues are discussed in more detail in conjunction with the archaeological information process in the following section.

7.5 Information process

The information process of the archaeology professionals grasps the entire life-cycle of information from the creation to the organisation, dissemination and use. The process is both multidimensional and multifaceted. It is iterative and intensive by its nature like all research in the humanities is according to the observation of Hauge [354]. Different types of information are being created, organised and used at the same time. Similarly a single piece of information may be organised, disseminated and used contemporaneously in different instances. The following sections situate the various phases of the information process in the life-cycle of information and elaborate the process by discussing it in the context of situatedness, politics, cognitive authority and trust.

The intellectual process, which models the sequence of the emergence of information, may be seen as a rotating parallel process, which penetrates the entire life-cycle of information. The most comprehensive discussion of the process and the emergence of archaeological information has been put out by Gardin in a number of individual publications from the 1970's onwards (e.g. [300] [301] [302] [304]). The model is based on a cyclical conceptualisation of the archaeological intellectual process, which is constructed of a continuum of acquisitions and comments, which lead to new discovered material and new propositions. The process is illustrated in

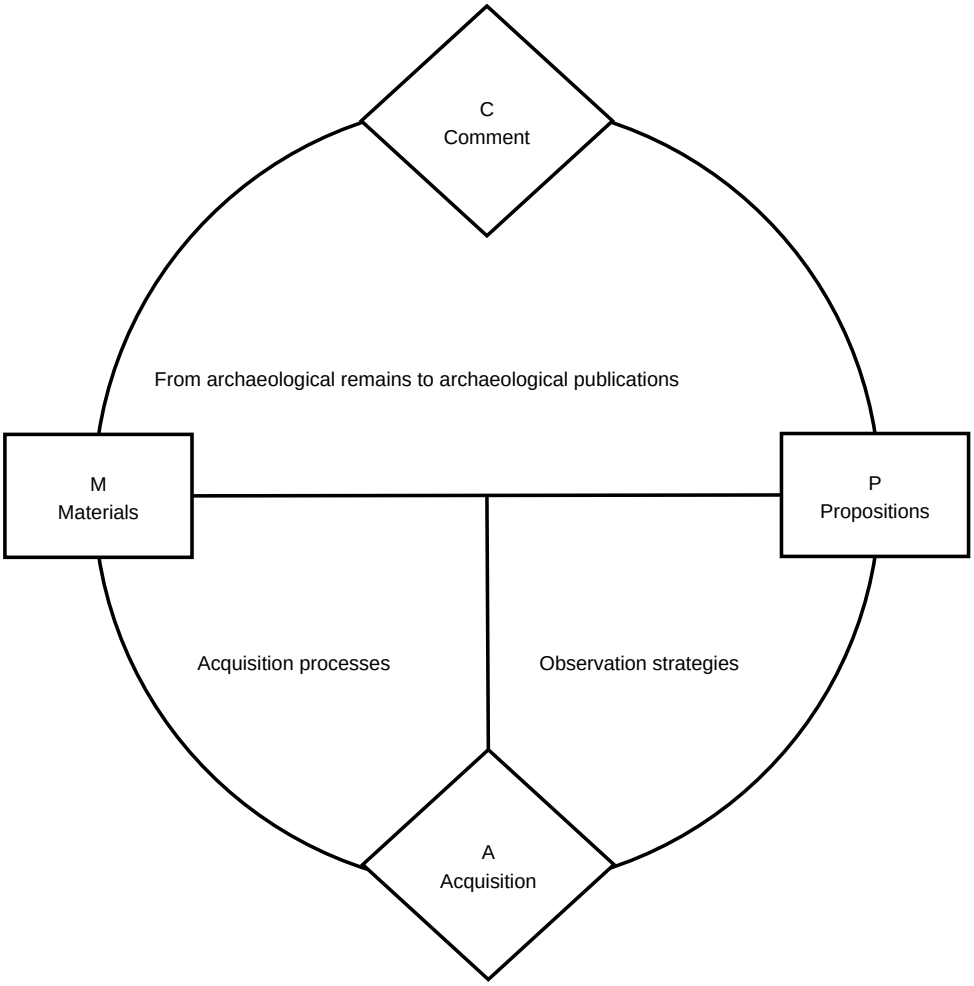


Figure 7.2: The chain of information processing in archaeology (according to [300, 6 Fig. 2])

figure 7.2. The intellectual process is built on a notion of a 'scientific process' (or a scholarly process) of the emergence of knowledge. Gardin summarises his conception of the scientific process as a spiral of subsequent constructs, where selection, description, ordering, interpretation and validation follow each other [300, 144 Fig. 26]. He elaborates the scientific cycle of induction, deduction and verification with the distinction between the empirico-inductive and hypothetico-deductive phases [300, 145 Fig. 27].

The cyclic general layout of the intellectual process proposed by Gardin is repeated in the archaeological information process, which emerges from the findings of the present study. While the model of intellectual process helps to understand the abstract level of archaeological reasoning, the explication of information interactions and information process provides the intellectual work with contexts and concretia. The gamut of the individual processes within the archaeological information process makes it act as a meta-process, which consists of an infinite number of individual situated processes. The essence of the information meta-process is

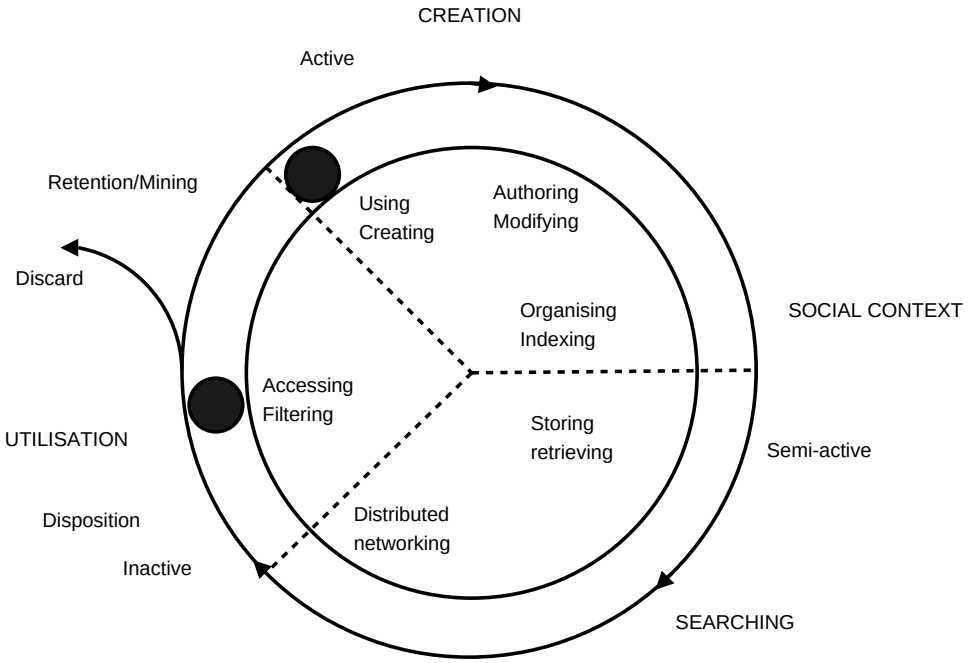


Figure 7.3: Interactions of the field archaeology work role

the layout formed by the individual instances of information interactions, which emerge both simultaneously and consequently within the different contemporary and succeeding information processes. The map of the different contemporary dimensional processes is formed by the work roles, which determine the *loci* of the individual interactions in the framework of the individual processes. The work roles penetrate through the meta-process, but have still their foci on the different phases of the life-cycle as illustrated in the figure 7.10 (for the individual work roles ref. Figs. 7.3, 7.4, 7.5, 7.7, 7.6, 7.8 and 7.9). The academic research is focally an activity of authoring and modifying information, while the infrastructural development and cultural heritage management are concerned with accessing, filtering and using existing resources. The antiquarian work role involves organisation and storing. The public dissemination and academic teaching roles encompass distribution and the field archaeology comprises using and creating.

The layout of the work roles on the life-cycle of information shows clearly that the archaeological work is multi-faceted even within the context of one individual work role. The occupational profiles of the individual informants distribute over the whole meta-process of archaeological information and the life-cycle of information. The typical workflows of the individuals on an institutional or at an operative level are difficult to establish. A characteristic profile consists of diverging roles, which are combined to a varying extent. In spite of the variety, the scattering of the individual foci of the information interactions is relatively low. The occupational profiles of some of the informants grasp the entire information life-cycle [e.g. O], even though the profiles were mostly biased towards some of the broad sectors of the life-cycle model, typically following the pattern of membership in an information behaviour group (ref. Fig. 7.11 for the information behavioural groups and their situatedness on the life-cycle of information).

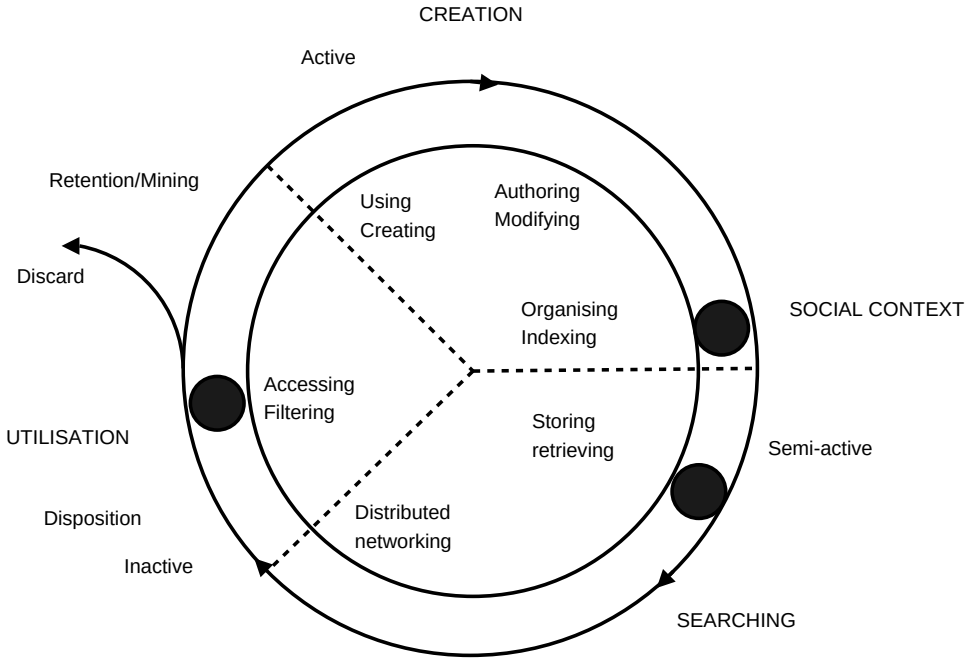


Figure 7.4: Interactions of the antiquarian work role

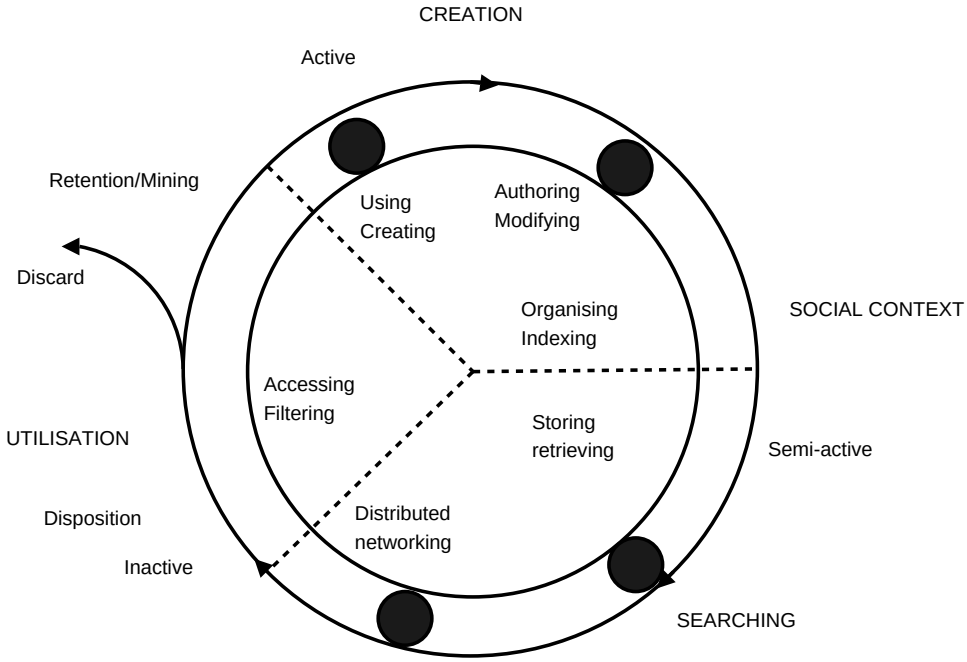


Figure 7.5: Interactions of the public dissemination work role

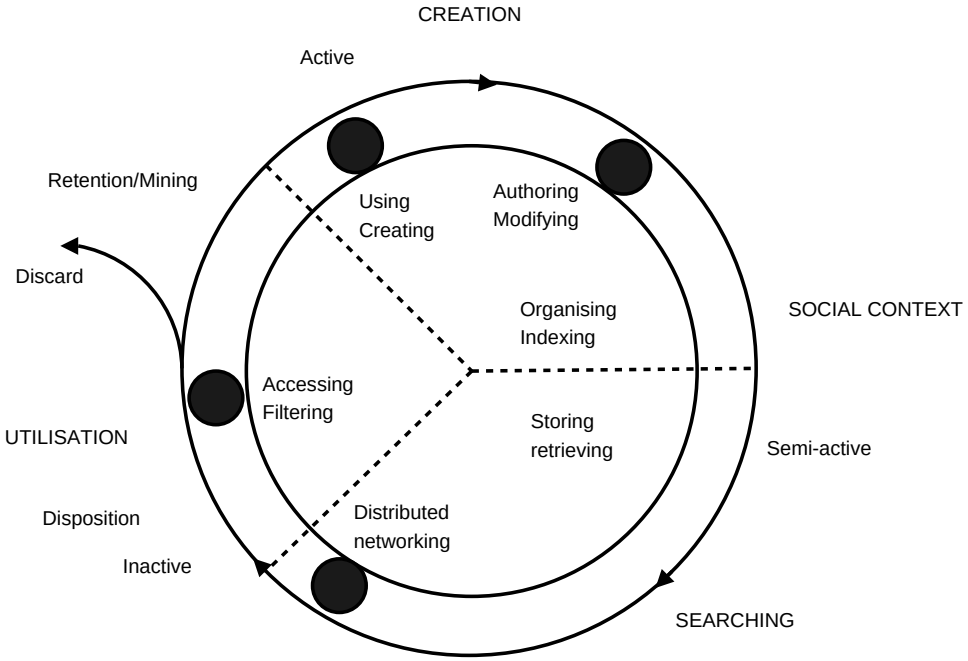


Figure 7.6: Interactions of the academic research work role

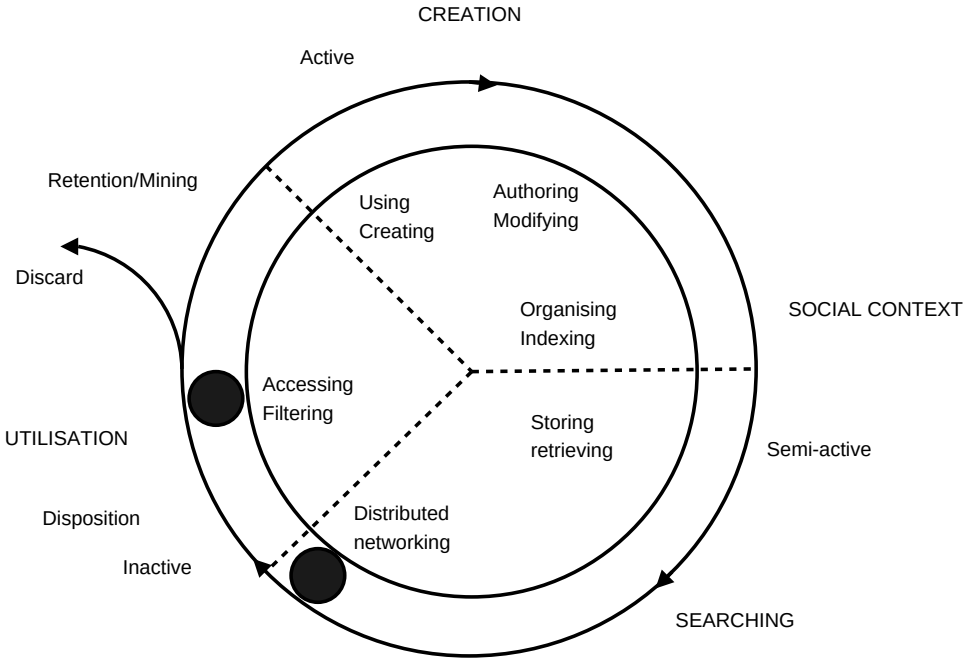


Figure 7.7: Interactions of the academic teaching work role

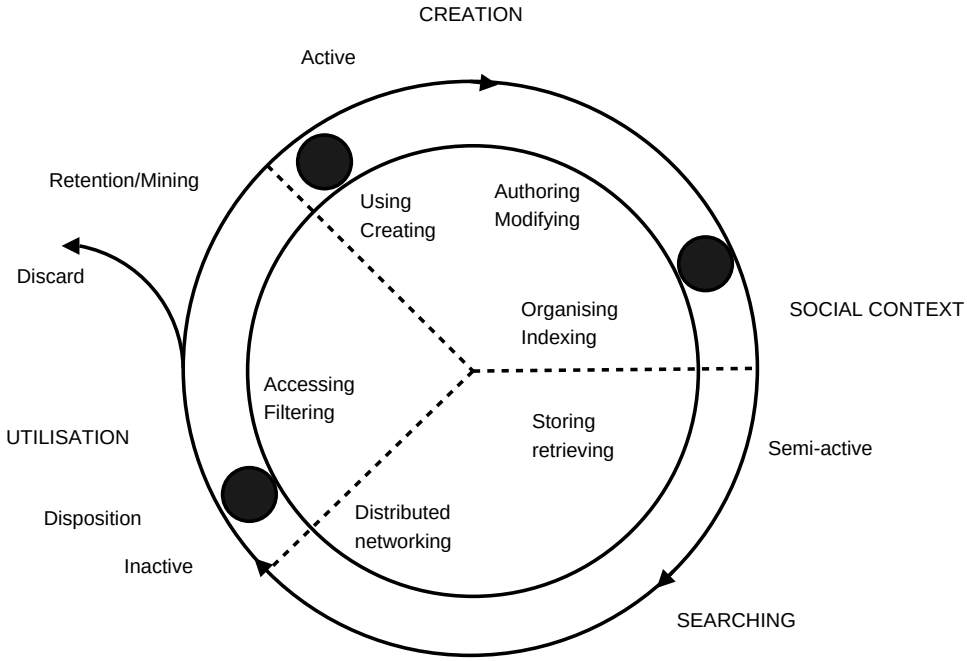


Figure 7.8: Interactions of the cultural heritage administration work role

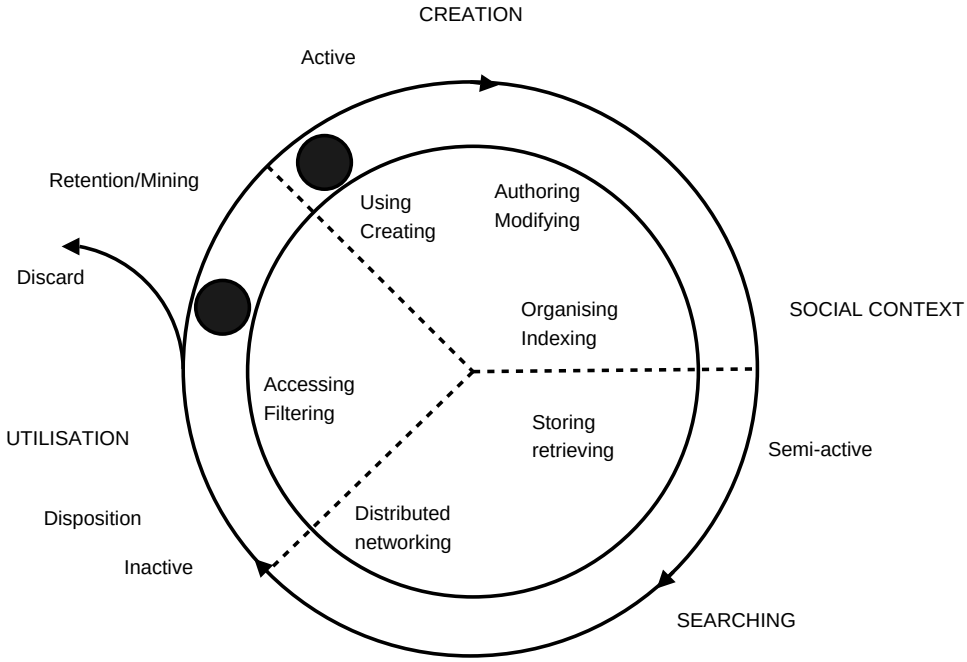


Figure 7.9: Interactions of the field infrastructural development work role

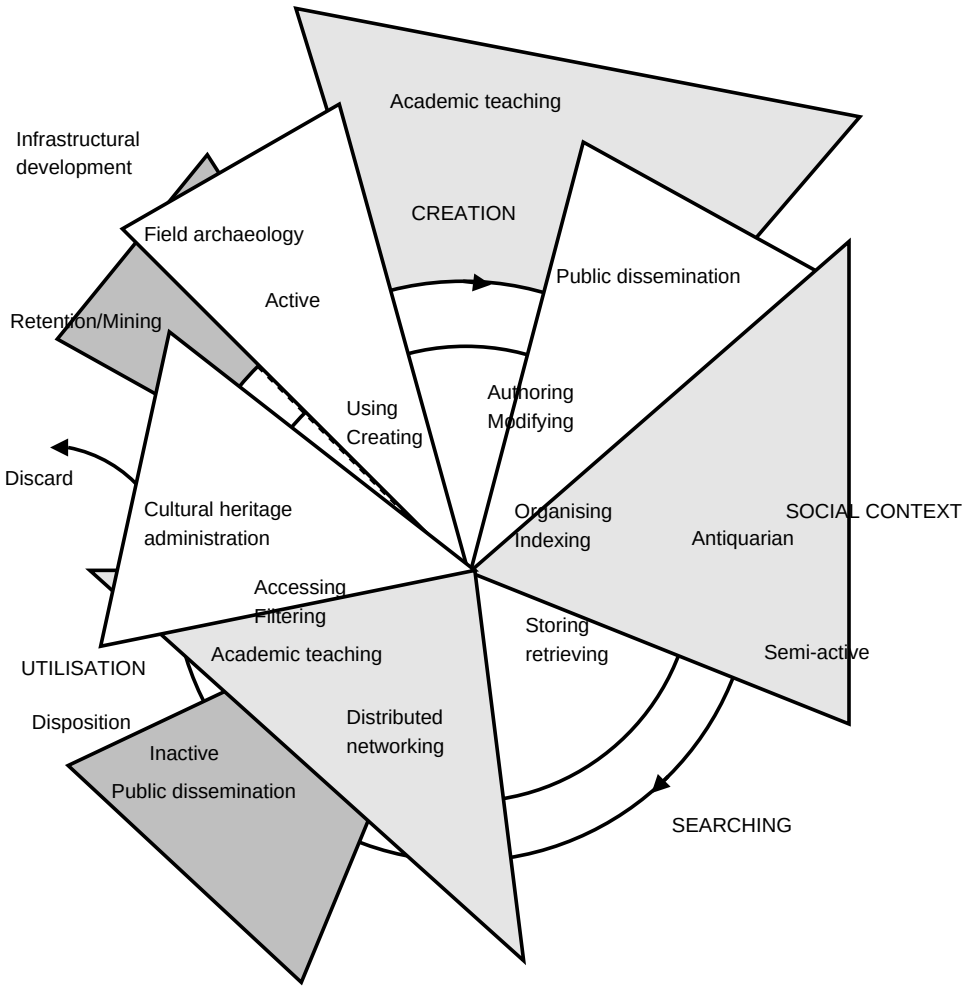


Figure 7.10: Work roles situated on the life-cycle of information

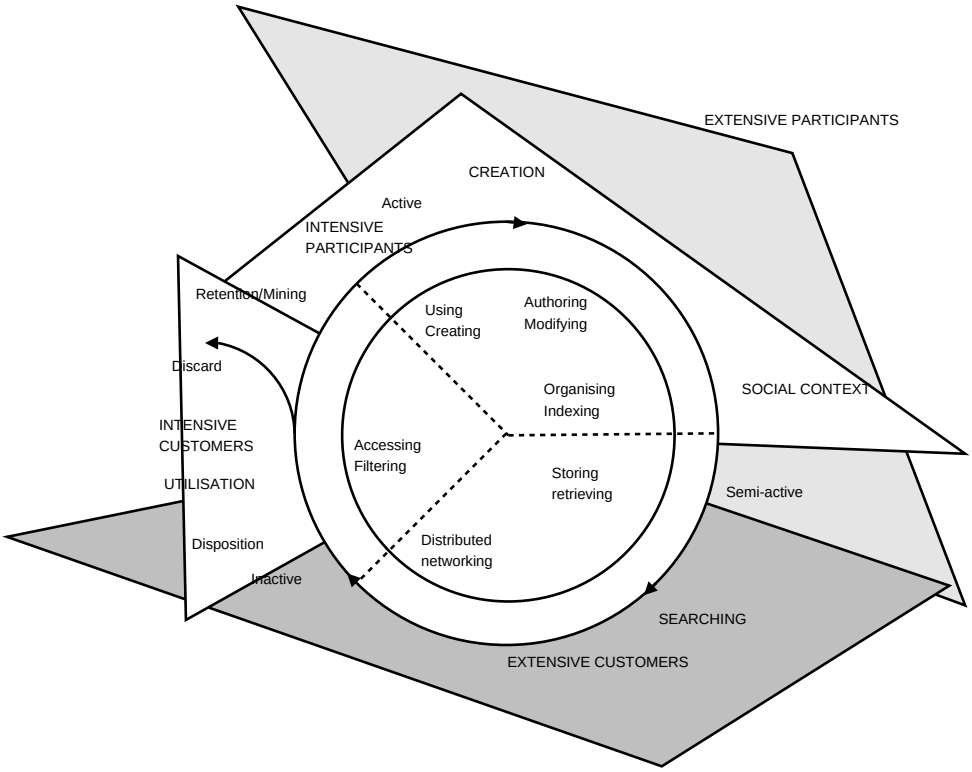


Figure 7.11: Information behaviour groups situated on the life-cycle of information

The process is characterised by the interplay of the information interactions. Another dimension of the movement is a cycle of specificity of the manipulated information objects. The consequent life-cycles, which work with the closely situated information objects, tend to move from general to the detailed and back again. When an object is excavated, the documented information is highly specific. The subsequent associations lead to broader interpretations through contextualisation, but in some point, as a critique of the broad conception, the focus turns once again towards the distinct and anomalous. A similar cycle is visible in the cultural heritage management, where the broad considerations of the importance and value are confronted with the small-scale information retrieved from the individual objects. The depth of the dive towards specificity is determined by the specificity of the purposes of the interaction.

The cyclic process may be visualised as a First-In-First-Out (FIFO) style stack. The entry point to the stack varies between each individual information interaction. The lower i.e. more detailed the entry point is, the more horizontal browsing work is required to reach a particular detail. The higher the level is, the more vertical search work is (generally) required to attain a desired level of detail. After the desired bottom is reached, the stack of knowledge is reconstructed, likely with a somewhat altered configuration.

The intricacy and embeddedness of the motivations behind the value and meaning of the archaeological work translates into implicity and diversity of the needs in the archaeological information work. Explicit information needs are difficult to formulate as there are no precise shared requirements regarding the content and the form of information. Despite the immanence of diversity, the archaeology professionals do share a common basis of information (the archaeological material) and they use common information sources. The shared information base is premised on the relative uniformity of the education and availability of the sources. The interpretations of the information sources do, however, vary to meet the specific requirements of the different systems of archaeological work. Also the importance of the individual sources depends respectively on the level of detail and the contextual richness, which is expected in each of the cases. This kind of determination of the importance of the information sources makes the construction of the layout of the individual work role specific information horizon maps notably disparate. The maps become in essence, pointilist aggregates of the individual maps, resembling of the notion of *information mosaics* proposed by Solomon [705].

The different worlds of information coincide, however, on the level of the individual information sources and repositories, and on the level of work role systems, where the use cases become linked to one another in shared environments or grounds of information. Pettigrew describes an *information ground* as "an environment temporarily created by the behaviour of people who have come together to perform a given task, but from which emerges a social atmosphere that fosters the spontaneous and serendipitous sharing of information" [586]. Cultural heritage professional may need to consult a field archaeologist on a land-use project, antiquarians and museum educators often work with academic researchers in exhibition projects and the infrastructural developers interact with a multitude of parties in effort to provide appropriate tools for archaeological work. All of these cooperations form information grounds, which do essentially bring the archaeological information work together.

7.5.1 Situatedness of the information process

7.5.1.1 The contexts of situatedness

The observations made on the archaeological work and information work processes give indication of the resonance of several factors, which contribute to the construction of the situations and contexts, where the knowledge emerges. The explicit processes of information work address the constituency of archaeological material, data and published information as forming the locus of knowledge formation. The effects of the situation and contexts of the emergence of the archaeological material and information, personal influence of the individual archaeologists and the social life-world within and outside of the communities of archaeologists, are implicitly acknowledged in some of the practises of information work. The implicit processes remain, however, highly tacit and thus unmanageable in other than *ad hoc* terms. Experienced archaeologists have an insight based on their experiences, how to read archaeological information, but when the context of the reading becomes sufficiently alienated from the original context (e.g. because of the time), their capability to understand the information becomes increasingly difficult.

The interpretation of the archaeological material and the subsequent formation of archaeological knowledge is affected by a diversity of subjective factors on each level of the interpretation [777, 487]. Innovation and the novel interpretations in archaeology are products created by individuals who refer to their own conceptions and frames of reference, which on their turn are springing further from the social and cultural context of the referrers. The notion of furthering the emergence of knowledge is dependent both on the coming up of the new interpretative frames and a continual critique of the current and past approaches.

Archaeological material and information about the material are important, but even more important is to know the provenience of the material, the method of its acquisition and for which purpose it was originally collected. The information on the provenience is conditional on the ability of the user of using a set of data as a comparable primary material to the firsthand observations of an archaeologist. The importance of provenience applies broadly to all social science research. Researchers are reluctant and unable to use secondary data if it is lacking information about the data collection methods used in its acquisition. Rice underlines the salience of proper contexts by stating that "the problem of access for research data is more than discovery" [620]. The difficulties of understanding earlier information, and the consequent reluctance and inability to make tenable references to it, challenges the rationality of preserving any data. Therefore the process of collecting and preserving data should emphasise the importance of capturing and recreating the relevant and trustworthy contexts of the original information.[9] Researchers need to know how the information was gathered and how the reasonings were made in order to be able to judge whether the claims make sense from the point of view of their own research. In this sense, the validity of the data acquisition should not be evaluated only from the technical point of view (i.e. the validity of the data collection method). The reliability and suitability of the data needs to be judged accordingly to its perceived quality.

Considering the findings of the present study, it seems impossible to reject the basic constructivist proposition that knowledge is in a constant state of the making. In contrast to the constructivist viewpoint, however, the findings of the present

[9] Ulisse recognises a similar problem in the web publication of the archaeological records. The information is often available without being usable for most of the visitors [783].

study suggest that the process of emergence of the knowledge could be better described as something 'happening' than something 'being done'. Even if a lot of knowledge related activity is intentionally knowledge orientated, the studied material shows clearly that the constituent factor behind the eventual knowledge is not 'something being done', but rather 'something happening, because of a diversity of things is being done'. The archaeological fieldwork provides means to construct an estimation of past human activities in the relative vicinity of a precise geographical location. The actual estimation is not, however, a predetermined construction, but rather an amalgam of intentions, and of contextual, systemic, infrastructural and environmental determination. The process is controllable, but only partially. It seems that the most fundamental aspect of the archaeological information work is that knowledge and information are not constructed by people alone, but that the knowledge and information participate the activity as actors of equal importance as the people.

7.5.1.2 Warrants, affordances and constraints of situatedness

The notions of warrants, affordances and constraints (discussed earlier in Section 3.1.3) offer some basis for understanding the systemic formation and situatedness of the archaeological knowledge. A notion that an eventual knowledge claim is dependent on its referential data, is seemingly trivial. However, considering the process of making a knowledge claim out of preexisting information, data and knowledge, in the first place, the outcome is far from being unambiguous. The process of collecting knowledge assets does not end up in a predestined knowledge claim. Reasons for a particular variation may be found both in the individuals and their cognitive processes, and in the social context. Besides in the information process, the constituent constructors also reside in the structural factors of form, organisation and presentation of the claims. The infrastructural characteristics (formation process, structure, and functionality of any individual knowledge organisation system) afford certain distinct types of secondary knowledge claims to take shape. Respectively, certain competing knowledge claims are more unlikely to emerge within the confines of a given system than some others (ref. Section 3.1.5).

The findings of the current study point out the affordances and constraints in a context, in which the informants described their information work. Even though the contemporary archaeological research tends to prioritise social and cultural dimensions of the past when contemplating archaeological remains, the process of documentation and especially of storage and archival of the preserved objects, impedes addressing these precise questions. The catalogues and publications afford essentially the type of research, which is outlined by a classification of the finds according to the materials, the size of the objects and their provenance, instead of the questions, which would demand a classification according to the functional categories or visual characteristics of the objects [I, J, N, O, R, V]. Similar difficulties are immanent with the research designs aiming at comparisons between various sites, locations and periods. Such attempts are practicable only in the rare projects with enough resources for years of laborious studies and accumulation of the designated researchers' experience and knowledge on the materials.

The prevailing, relatively antiquarian, data management procedures seem to be warranted by the assumed priorities of the work, which tend to be guided by the manageability of the primary operations (i.e. investigation and documentation). The assumed original functions and perceived visual characteristics of the objects are necessarily more subjective notions than the quantitative observations, which

prevail in the documentation work. The weight of an object is standardisable and therefore, the documented characteristics are likely to show only slight variation between the individual observations. The quantitative data is easier to produce, store and manage, which makes it a practical choice for the information workers, who are basically expected to file formally correct reports and documents, instead of using them immediately in scholarly research or public presentation.

Attempts have been made to improve the descriptiveness of the archaeological documentation. Guidelines have been introduced to get the archaeologists to include more interpretative elements in their reports. The designers of the new field work data and collection management systems have taken endeavours to catch more subjective and informal comments besides the quantitative and formal indications [N, R]. In spite of the ambitious attempts, much remains to be done both with the technical and organisational issues in order to broaden the prospects of phrasing the archaeologically relevant questions, and to open up the collections to constrain less and afford better the archaeological research.

When discussing the affordances and constraints of the archaeological information management and knowledge organisation, it is important not to confuse the surrogate level infrastructural aspects with the characteristics relating to the form and structure of the data itself. As one of the informants expressed, the archaeological view of the past tends to privilege object-centric interpretations of human thinking and activity, while the historians perceive the past often as a conspicuously literary, in spite of the frequent explicit theoretical undertakings to alter this viewpoint [L]. These tendencies do not relate to the affordances and constraints posed by a system of organising archaeological or historical source material, but to the form of the source material itself. It is reasonable to suggest that the material remains are bound to privilege materialistic interpretations. The physical form of an artefact may be described as an infrastructural characteristic of a first level of abstraction. Similarly to its other qualities, the form represents a set of constraints and affordances. Equally meaningful source of essentially different affordances and constraints is, however, the archaeological knowledge organisation system, which is used to describe and classify the physical data in order to alleviate its further use. The infrastructural level of knowledge organisation is capable of removing the constraints of the first (physical) level. The prevailing efforts to describe the physical world using conspicuously different e.g. textual and graphic representations do provide affordances to pass some of the hindrances of the physical constraints, but does not *per se* empower the use of the physical data.

According to the findings of the present study, the contribution of the ecological approach to the knowledge organisation research is considered to be in the process of making the diverse contextual factors of the knowledge organisation and information work more explicit in the form of affordances and constraints. The collection management systems do have to grasp data about the physical characteristics of the stored material, because it is highly relevant for a significant amount of primary research and it serves the recognition and retrieval by providing a set of relatively unambiguous descriptors. The ecological viewpoint alleviates the inclusion of mutually dissimilar descriptions and the simultaneous exploration of diverse schemes for organising the data. The questions of choosing an appropriate content and explicating a purpose for the provision of additional information may be based on a more precise motivation of tendering distinct affordances, which serve the users of the information. Similarly, the constraints may be lifted or maintained on a more warranted basis than a guess of the user needs and behaviour.

In summary, the fundamental proposal regarding the archaeological information process is that it is important to attempt to warrant an infrastructure, which affords the formation of appropriate claims from the point of view of the system of information work. Similarly, the functioning of the infrastructure needs to embed and recognise the constraints posed by the data, which originate from the cognitive, social and cultural contexts and situations, in order to become warranted in the frame work provided by the notion of work.

7.5.2 Politics of the information process

7.5.2.1 Politics of archaeology

Archaeology is a scholarly discipline and a profession of political relevance like any human discipline necessarily is. Shanks and Tilley underline that because "archaeology is of the present" it "involves taking an ethical and political stand on the past in the present" [682, xxi]. The values of archaeology are not merely subjective [682, xxi], but the interpretation of the archaeological material is not simply an activity of explicating and disseminating objective facts about past human activities. Archaeology is about expressing contextual and situated *claims* on the implications of the gathered evidence on past human activity (ref. e.g. [476] cf. [231]). The human past and the purposes, meanings and values of studying and preserving it, are essentially different to all spectators.

The political nature of archaeology is culminated in the long history of claiming cultural and national legitimacy through exploiting archaeological findings and discourses. Archaeological remains are frequently used to give historical justification for contemporary claims. As Díaz-Kommonen notes, the political and instrumental connotations may be both direct and indirect [231, 215-216]. Archaeological arguments have been used to support claims of domination and they have played and are still playing a major role in numerous projects of nation building around the world [690]. Archaeologist may represent a society or stance, which is not accepted by another society or another archaeologist. Different religious, cultural and national opinions do constantly produce conflicting valuations and meanings of the archaeological entities [681], which are by no means insignificant from the point of view of the archaeological information work.

The political nature of archaeology becomes manifest on a more mundane level in the colloquial work of the cultural heritage administrators. The sites and monuments, and their preservation raise passionate emotions. An archaeological site may be a grand source of pride for a landowner or the local community, to an extent that questioning its age or status, may cause difficult confrontations between the archaeologists and the locals. The claimed existence of archaeological sites is used to bring unwanted land use to a halt. On the other hand, sites are quietly disturbed to avoid time consuming and potentially expensive investigations, but also to keep away archaeologists, who are still from time to time seen as hectoring intruders. According to the informants, the situation was generally considered to have become better during the last decades with the exception of the maritime archaeology (ref. Section 5.4.2).

In spite of the political implications of archaeology, the archaeologists themselves tend to be reluctant to make political judgements even in the position of a cultural heritage administrator when the decisions are unavoidable. The informants acknowledged the necessity of value judgements, but tended to position themselves as 'neutral' experts rather than active policy workers, while they were

active in the cultural heritage administration and other related work roles [C, P, W]. As a government official, an archaeologist is formally not a policy maker, but an executor of established policies. Yet the consequences and interpretations made by the officials are of a political significance. Historians have been criticised of an emphasised tendency to avoid moral judgements and to hold a determinist position to past activities [796]. This notion also applies to archaeology. Scholars make unavoidable moral judgements and political decisions about the subjects of their studies, even if their intention would be to emphasise the neutrality of the accounts. As Vann proposes, it is exceedingly important to be pronouncedly aware of the political nature of the historical discourses, and as a professional, to take an active role in the pondering of the implications of the various scholarly proposals and viewpoints [796]. Because of these implications, it is essential to consider the accountability of one's actions, as Gorman underlines for the part of historians [328]. From the archaeological information work point of view, the relevance of these observations, which were originally directed to the historians, lies in the fact that the political resonance of the past also applies to the archaeologists and the archaeological information. An archaeologist discusses not only with the past, but draws the past in to a discussion with the present. Like the historians, the archaeologists are subjected to a craving of being explicit about the accountability of their actions.

The political nature of archaeological information and knowledge do have an impact on the related information work. It is important to provide cultural heritage administrators with an expert evaluation of the archaeological significance of a site. Information of the extents of a site have to be wide enough to grasp the whole area, which requires preservation. On the other hand, it is not economically or politically viable to protect unnecessarily large areas for the reason of being on the safe side. Every archaeological estimate and statement may always have a personal and societal (including economic and political), impact, which has to be constantly reflected in the course of the information work.

7.5.2.2 Politics of archaeological information sharing

The theory of information poverty (Chatman) bears a considerable explanatory power on the archaeological information work [155]. In spite of the outspoken aims to communicate archaeological knowledge among the colleagues and to the public, an individual archaeologist is, at least during the early stages of her career, in a state of *information poverty*. The informants characterised rather explicitly their colleagues in terms corresponding with the notion of *insiders* and *outsiders*, which is central in the theory: "she knows everybody, and everything, which is important around this subject" or "I choose to ask someone, who is a specialist in these things" (i.e. I am an outsider and the expert is an insider) (e.g. [C, D, W]).

In spite of the thrive to make the archaeologists to drift into the groups of insiders and outsiders, the uncertainty of the research work (combined with a craving for a wide recognition) maintains a breadth of dependencies within the community of researchers, [821] and also between the archaeologists and the public. Whitley's notions of *functional dependence* and *strategic dependence* illustrate well the dynamics of the dependencies in archaeology.[10] Whitley defines the functional dependence as a bond between the colleagues, which makes them to share information, ideas, and research results in order to construct further knowledge claims. A strategic de-

[10]The Whitleyan concept of mutual dependence has been used earlier by Fry [295] in information science context.

pendence relates to the necessity of convincing the colleagues of the salience of the claims for the collective objectives of the scholarly community [821, 88]. In the first place, a scholar is also strategically dependent on her peers for getting her claims accepted to the general scholarly debate. The dependence is mostly tacit, but becomes explicit in the social conventions of the community of the archaeologists. The modes of social information sharing (ref. Section 7.1.9), and the conventions of mediating trust, accuracy and importance, are guided by the internalised sense of mutual dependence.

The politics of the archaeological discourse and its expressions in the Anglo-American academic archaeology, have been touched briefly by Hutson [394]. The author makes several interesting observations and points out conventions of how the dependencies and the mutual prestige are constructed and maintained in the academic teaching, personnel policy and citing practises. Archaeology is a relatively small branch of research with a low number of permanent positions and a high percentage of seasonal work. This situation is emphasised in the Nordic context and especially in Finland, where the size of the archaeological branch was described by one of informants to be "extremely small" [E]. Small circles beget a situation where you have to maintain your position carefully to be able to get opportunities of work. Basically every archaeologist, who is working in the branch, is bound to fall into a state of deep reciprocal debt and gratitude with her colleagues [A-Z]. Correspondingly, an individual who runs foul of her colleagues, is in danger of becoming isolated from the community of archaeologists, and at the same time, of the archaeological work altogether [E].

The functioning of the institutional prestige of the academia follows slightly different patterns in Finland and in Sweden than, for instance, in the United States (cf. [394]). The informants did not put a special emphasis on the prestige of the individual academic institutions. Everyone was conscious about the institutional background of their and their colleagues' education, and of the major differences between the university departments. It seems that the relatively small number of the degree programmes in both the countries tends to favour the formation of collegial bonds between the alumni of the individual universities, instead of a broader clustering to the elite and non-elite institutions. The small number of the chairs also entails that basically everyone who is working on medieval archaeology in Sweden has studied in Lund at least for a period, because the subject has not been available anywhere else. The common institutional affiliations are not, however, necessarily a rule. Those individual actors who are interested in small specialist topics tend to construct their networks over the institutional boundaries. They develop a dual membership in the institutional and inter-institutional communities, or *invisible colleges* using the concept of De Solla Price [221]. The information and work horizons emerge to embrace the both spheres of interaction. The observations correspond with the remarks of Zuccala that the role of subject specialism in the establishment of the invisible colleges is typical in relatively young and small communities of researchers [854]. In the Nordic context, the small size of the community of the archaeologists and the consequent high influence of the prominent individuals is capable of inducing rapid changes of focus when, for instance, a professor or another executive office holder is replaced by a specialist of another field of archaeology. In this respect, the smallness of the archaeological community makes it constantly established and reestablished (thus 'young', ref. [854]) in many special areas of interest.

Hutson's observation on the prevalence of the "academic" archaeology in the

university curricula is apparent also in the Nordic countries (e.g. [C, G, H, M, S], also [401][400][41][35] [33]). It is not altogether clear whether this should be taken as a symptom of underrating the cultural heritage management or other sectors of professional (versus academic) archaeology, or merely as a quality of the academic education, which emphasises the importance of a common scholarly understanding of the subject and which tends to leave the professional training to the employer organisations (cf. [394]). In spite of the intrinsic motivations of emphasising or deemphasising scholarly archaeological research, the academic viewpoint becomes underlined in the education.

The smallness of the archaeological community in Finland and Sweden consequently restricts also the emergence of a wide spectrum of journals and the formation of hierarchies within the publications. The importance of the chosen publication channel is recognised to be crucial in addition to the formal scholarly appearance of the scholarly contribution and an adequate indication of the references. Because the impact of an individual publication is generally restricted to a small topic or geographic coverage, the system of journals has developed accordingly. The influence of editorial themes and individual editors as gatekeepers of legitimate archaeological knowledge, is necessarily even greater than in the international journals [A-Z].

The discussion between half a dozen Finnish archaeologists at a bulletin board system (BBS) called "Burned Bone" in January 1989, run at the time by Jussila (selected transcripts have been published on the web), give an interesting additional perspective to the social organisation of the Finnish archaeology at the time [427]. Jussila himself polemised the tightness of the social circles and its effect on publications and on the archaeological debate. The other participants expressed more moderate views and underlined the equal possibilities to publish and participate. In a sense, both the views do bear significance. The observations on the few number of archaeological publications and a relative lack of debate pointed out in this brief discussion thread from 1989 and in the interviews conducted for the present study, are in this sense indicative about the general picture of the social organisation in the Finnish and Swedish archaeological debate. There is a freedom to publish and participate as long as the participation follows the conventions of the single existing community. It seems that much of the occasional friction may be traced back to the evolution of the consensus within the community, and the exiguity of debaters, which is coupled with the consequent inability to establish truly parallel communities of debate.

The layout of the system of archaeological publishing and publications is not necessarily a mere cause of the social organisation, but also its consequence. The apparatus of journals does not need to be very broad, if the legitimisation functions primarily on the level of people knowing each other ([A-Z], ref. also [24, 17-18]). The organisation of journals and publication series follows a structure, which is established by the social proximity of the participants. It is emphasised by the distillation of the subject specialisation, which is occasionally further emphasised by the geographical proximity of the principal actors. The distinction is not made at the moment of publication, but long before at the stage when the archaeologists develop their views and frames of research.

In this respect the idea of promoting "databases" (i.e. information repositories) and other new media as scholarly publications [308, 66] is a difficult task. The question is not only a matter of emphasising a prestige of a medium, but also of developing datastructures, which allow the embedded procedures of distinc-

tion, evaluation and comparison to exist, and which support the formation of large enough entities so that the individual contributions may become self-sufficient in the breadth, which is necessary for establishing the contributor's prestige. Besides the 'political' requirements of the media, it would be important that the prestige would be in fact, based on the publications and not on the existence of the intangible social networks. The failure of binding the mechanisms of scholarly control and the emerging knowledge organisation systems together may compromise the perceived usability of these new systems.

7.5.2.3 Politics of archaeological relevance: novelty, representativeness, accuracy and physicality

The politics grasp not only the knowledge and experience of the past and its meanings. The archaeological discourse is political also on the level of communication and information work. The qualities of information and its organisation do matter like that an individual belongs to a 'community of being informed' (i.e. a community which becomes informed and where information is exchanged). The considerations of *relevance* (ref. [659][193][105]) explicated by the informants offer some interesting insights in the notions of scholarly and political situatedness of the archaeological information. The notions of relevance, in the sense of what is important, topical and of high-quality (i.e. 'good') information (cf. [659][193][105]), are matters of choice and judgement far beyond the measurable. The current study indicates clearly that the interviewed archaeologists were focussed on the topical instead of the paradigmatic relevance. The focus resembles the case of historians in the study of Talja and Maula [760]. Almost all explicit information seeking in archaeology is framed by topic instead of a paradigmatic, theoretical or methodological viewpoint. The latter kind of relevance does carry some resonance in the academic research, but generally the role of theories is minimal outside the scope of the explicitly theoretical archaeology [A-Z].

Whitley has recognised that scientific activity is closely linked with a tendency to promote novelty, even beyond the actual innovations. Apprehension of particular novelties does not necessarily follow directly the path of utility or quality of the results, but rather a path, which is collectively approved by the scholarly society [821]. In the Whitleyan perspective, archaeology has a dual relationship with the notion of novelty versus representativeness and usuality. Novelty and unusuality are of interest within all the seven work roles. In the archaeological discourse, the unique and unusual represent something interesting, worth preserving and something, which may change paradigms. The representative and the usual do, on the other hand, indicate something of the prevalent patterns of the everyday life, which has been the primary scope of interest for the post-antiquarian archaeology. As generally in science, the representative findings do serve in a crucial role of confirming the results of the earlier research. They lack, however, the affectively important novelty value, which does still guide the attention towards the unusual findings, in spite of the acknowledged importance of finding something expectable [A-Z]. As one of the informants explicated, an exciting representative find would be to unearth e.g. an ordinary, well preserved ship from a scarcely known period, which would be simultaneously something entirely new, but still serve as an indication of the common patterns of everyday life [W].

Besides the novelty and representativeness, the archaeological information is expected to be accurate. The status of archaeology in a middle position between the scientific research methods and the scholarly interpretations has brought together

a coexistence of measurable and hermeneutic accuracies. The documentation work and the scientific analyses are expected to be of high precision within the context of available instruments. At the same time, the interpretations based on the measurements, are accurate on a different scale. The idea of conducting as accurate research as possible has a certain meaning, because the scientific analyses do often benefit of precise data. The unevenness of the measurable and hermeneutic scales has, however, set off some considerations on the feasibility of the painstakingly precise measuring of some specific aspects of the materials, because many other aspects of the same materials remain unmeasurable. Furthermore, the final conclusions made of past human activities are always involving a decisive subjective factor, which is largely independent of the precise measures ([A-Z], ref. also [330][421, 66]). The contemporary field archaeology uses high precision total stations[11] for mapping archaeological sites, and for fixing the positions of the stratigraphic contexts and individual finds. The measurements are implicitly taken as direct indications of their original relations at the time of their covering, even though it is known that the tectonic movements and the human, floral and faunal disturbances are capable of moving the materials over considerable distances and thus mixing the contexts.

Besides the two questions of novelty and representativeness, and of accuracy, the third important aspect of relevance in the archaeological research process is the notion of physicality of the studied materials and the research results. The reputation, which is gathered during the publication of novel results and their diffusion, is important in the wider temporal and spatial context. However, at the moment of finalising a research effort, the most important aspect is the existence of a tangible thing to touch and hold. The physicality of the studied material and of the finalised publication bear a notable significance to a researcher. Similarly the informants remarked that the physicality of an exhibition, publication or a display is meaningful for the public audience [e.g. I, L].

Some of the informants were significantly optimistic about the emergence of the techniques of digital publication and dissemination of information, which might substitute the definite need of a concrete physicality. Several informants did, however, place a continued emphasis on the physicality of the information and were not inclined to see it substituted by any indirect measures. The prevalence of an attachment to the physical objects springs obviously from the basic definition of archaeology as a study of past human activities based on its material remains. The informants tended to also express a somewhat deeper cognitive, social and cultural attachment to the physical materials than that of a purely objective need to measure an object. The importance of visiting a site and the possibility of touching an object was underlined in many occasions [e.g. A, I]. The contribution of the physical contact was generally explicated by the better possibility to understand the object of interest and its contexts [e.g. W, B]. The precise benefit of a physical 'being there' seemed to be difficult to establish. It seems, however, that the *presence* (ref. Section 3.2.2.4) has a decisive impact on the functioning of the archaeological reasoning and it is not easily substituted by another form of communication. The 'being there' bears definitely an intrinsic value of its own.

[11] A measuring device.

7.5.3 Cognitive authority and trust in the information process

7.5.3.1 Authority and trust in the information work

Knowledge organisation and information management raise an issue on the reliability and relevance of the information and knowledge. According to the terminology established by Wilson, the bulk of the archaeological knowledge could be described as *second-hand knowledge*. Wilson describes the second-hand knowledge as knowledge provided to us indirectly. Respectively, the first-hand knowledge is based on direct observation or personal experience [832]. In the field archaeology, the knowledge is typically perceived as being of the first-hand kind. The direct field observation is apparently as close to the first-hand knowledge as the knowledge in archaeology can be. Still it could be argued that even the primary observations are based on consequential evidence, because the primary interest of archaeology is past human activity instead of the material remains observed in the field.

The essential motivation for discussing archaeological knowledge in the terms of first-hand knowledge and second-hand knowledge, is that the concepts elucidates the issue of reliance on an external authority. Wilson points out that being dependent on the second-hand knowledge is a direct implication of being dependent on others who mediate information in a reliable and trustworthy manner [832]. The quintessential characteristic of the second-hand information is an abstract idea of its truthfulness, which manifests itself through the authoritativeness of an information source and its consequentially perceived reliability. Wilson refers to this assumed role of the perceived reliability as the *cognitive authority*. The concept is defined by Wilson as "what we can take to be true and properly arrived at" [832]. Besides the cognitive authority, it is suggested that another concept of *affective authority* may be used to cover the affective dimensions of the authority relationships.

The informants seemed to prefer indirect dependencies instead of direct ones. Especially negative the attitudes were towards authoritative relationships, where there might have been a hint of hierarchical chains of authority. Most of the interviewees reacted in a conspicuously negative manner towards the idea of citing or trusting someone, only because of her established position within the scholarly discipline (e.g. [G, M]). Yet the informants indicated that they were inclined to consult or cite experts and authorities in diverse matters, which are out of the core of their own expertise, if they themselves 'knew' that the specific expert was authoritative in the particular field.

The authoritativeness of the information and its outlook are of a constituent importance in the scholarly community and its functioning. It seems, however, that within the context of the present study, the source of authority was in many instances after all, a person, not the information.[12] Even if the informants would have liked to rely on the information, they did in fact recognise their reliance on a personal authority. The reliance becomes especially prominent, because archaeology mostly lacks a widely approved hierarchy of esteemed journals. In sciences and medicine the journals serve as a complementary framework of the formation and maintenance of legitimacy and trust (cf. [769]).

The definition of the reliance was expressed by the informants in terms of information merely, because a personal confidence (cf. the symbolic capital of Bourdieu [109]) is not considered to be a proper way to express the source of cognitive or affective authority. A likely explanation for the prevalence of the personal au-

[12] The phenomenon recurs in the observations of Van Leusen on the concerns about the power wielded by an editor of a web guide [794].

thority relationships might be expected to be consequential to the small size of the scholarly and professional communities in Finnish and Swedish archaeology, and especially in the various sub-disciplines. As most of the citings and consultation is concentrated to the group of people known personally to the referrer, the references are bound to become person, instead of information, centric. Consequently, when this is acknowledged, it becomes a necessity to undermine the personal authorities and to underline the intellectual independence in order to maintain the scholarly and professional stance of the one's own activities.

The phenomenon of simultaneous importance and undermining of the formal personal dependencies is not confined to archaeology. The findings presented by Bron et al. (discussed earlier in Section 7.3.2.2) on the use of library services bear similar indications. The information work is explicitly information centric, but the most trusted specialists, i.e. librarians (in the Bron's case), are the ones known best and the ones known to have personal experience of the research in the subject field. According to the combined evidence, it seems plausible to suggest that the scholarly information work is generally more inclined to build on personal confidence and authority relations, which are expected to manifest as higher quality and rapidity of service. The explicit need to accentuate the intellectual independence was visibly higher in the group of junior informants, which conforms with the findings of Seldén on the information behaviour of the social science researchers [676, 201].

A relating concept to the cognitive authority is *trust*. The role of trust in the information work has been debated in a number of contexts from the human-computer interaction [278][277][192], computer supported cooperative work (CSCW), records management [241], and cultural heritage informatics (e.g. [638][725]) to the information retrieval (e.g. [442]), knowledge organisation and information management [392]. Trust or authenticity is not a static thing [725], but rather a volatile and contextual quality. The studies do generally tend to suggest that it is a critical factor in human activity. Closely similar relating concepts are the relevance (e.g. [659][193][105]), quality and authority [625], reliability [383], credibility [278], and appraisal (which is used mainly in archival science, e.g. [184][619]). Independent of the individual terms used to denote different aspects of the problem, the management perspective adopted in the present study suggests the primacy of its relational nature. As the objective of organising knowledge and managing information is in empowering organisations and processes instead of actors and entities, it is important to place the emphasis on the whole context where the notion of is topical. The salient point of interest lies in the actors and locations and the moments of emergence, functioning and decay of such relations. In a somewhat simplistic sense, it might be argued that much of the debate related to the reliability and trust, may be conceptualised as states, which are construed through the existence of the cognitive authorities (e.g. reliability, trust, relevance), or as the politics, which contribute to their formation and dynamics (e.g. appraisal [184][619]).

In spite of the diverging perspectives, the earlier studies suggest rather convincingly the central role of the cognitive authority and trust related issues in the information work. The networks of trust guide the social organisation of information work, and have a deep effect on the information seeking, source use and the practises and modes of the information production. Their importance has been pointed out to be especially focal in the social and intellectual organisation of the scientific and scholarly studies [821]. The scientific institutions and scientists have been, and are, a considerable source of the cognitive authority in the modern societies. Science is based both on the existence and the mediation of the cognitive

authority, and simultaneously it has been taken to be a determinant of an informational legitimacy in the society [821][132][24, 15].

The principal implication of the observed importance of the notions of cognitive authority and trust point in the information interactions is that the successful functioning of an information process is significantly dependent on the relations of confidence between its participating actors and components. Therefore it is the relations, their dynamics and *functioning*, which should be underlined instead of the *existence* individuals and organisations.

7.5.3.2 Authority and trust in archaeology

Archaeology, archaeologists and the institutions, which carry out archaeological research, preservation and dissemination of information, are sources of cognitive authority for the society on the matters relating to its archaeological heritage. They are also significant contributors to the societal experience of the past. Apart from being itself a cognitive authority in the scope of the society, the same forms of cognitive authority are functioning in a collective sense also within the discipline of archaeology itself.

The explication of the archaeological information source use and information horizons (Sections 7.1 and 7.2) gave in several instances indication of where the effects of the cognitive authority and trust were significant. A prevalent theme in the discussions with the interviewees was that the informants emphasised a need to consult and work with the information by themselves to see whether 1) *the content appeared to be trustworthy* or not, in the light of their own experiences (ref. especially Section 7.1.1). A similar tendency is visible in the preference of consulting monographs instead of articles in order to be able to attain a complete picture of a phenomenon within the present scope of interest. The second notion relates to 2) *the pertinence of the social contacts* with the colleagues (Section 7.1.9) and a (tacit) awareness of the social organisation within the discipline when it comes to the information seeking, publishing and use. The importance of the social organisation as a locus of cognitive authority has been acknowledged earlier in the literature in both the contexts of using the social network as a primary information source (i.e. second-hand knowledge) and in making value assessments of other sources based on the social information [832][625].

Besides being visible in their social or individual characteristics (e.g. the stature of the author or the importance of a site), the authority constructs are also situated in the 3) *outlook* and 4) *the structures and infrastructures of information*. The prominence of the archaeological investigation reports as the most important secondary (re)source of information, and their relatively standard layout and contents serve multiple functions in the archaeological information work. The structure of the infrastructure, which is formed by the reports serves to ensure a required degree of integrity of the documentation and the subsequently constructed information. It also serves in providing esteem to the report and to the eventual follow-up publications. In a similar infrastructural manner, the notion of the academic 'quality' of the research papers is articulated in part on the basis of the external characteristics of the publication, journal or book where it was published, and from which repository (i.e. a library or an electronic provider), the paper may be eventually retrieved.

Besides the discussion of the information source use and the information horizons, also the analysis of the information interactions gives an indication of the importance of the trust and authority issues. The prevalence of the interaction criteria

such as the *appropriateness*, and especially, the *authority*, are based on the established or emerging notions of trust, which affect the interactions.

Summing up, the presence of trust appeared in the interview material of the present study in the following four contexts:

1. *Factual content*: All informants indicated that the most important factor affecting the trustworthiness of information was its factual content as it is judged by the user in the light of her personal knowledge on the subject matter (ref. [832, 169]).

2. *Social organisation*: Most of the informants tended to trivialise the authority of their individual colleagues on their judgements, and to accentuate instead, their own factual judgement [e.g. D, M] (i.e. the *factual content*, above). The peer-to-peer relations within the discipline of archaeology were valued high in contrast to the formal hierarchical relations.[13] The importance of the horizontal relations was emphasised by the fact that within the discipline of archaeology, the social contacts were conspicuously addressed as 'colleagues' whereas the idea of an 'expert' was much more frequently attached to the crossdisciplinary contacts. The findings indicate the importance of the social organisation in the information work as a whole. The horizontal relations based on relative equality and direct personal acquaintance between the participants seemed to be especially essential for the emergence of the cognitive authority. The acquaintance itself seemed to be typically bi-directional, but it might have been initiated originally by a one-directional 'contact' of one person reading articles published by the other one. The notion of a social organisation is related to the 'recognition of authorship' (i.e. trust based on the recognition of the author of a text) explicated by Wilson [832, 166], but also contributes to the explaining of the publication sponsorship (i.e. the work has been published by a trusted collective body).

3. *Form of presentation*: Considering the principles of scholarly communication, which demands accurate documentation of the references and a motivation for the knowledge claims, the learned content of a contribution is tightly weld together with a proper format and outlook of a document [e.g. A]. Even if the content is considered to be the aspect that actually matters, a convincing and formally correct outlook of a scientific article contributes substantially to its cognitive authority. Illustrative example of this phenomenon is the number of bogus papers submitted and consequently accepted to various scientific journals and conferences (e.g. [73][534]). The authoritative form of an academic presentation and a consequentially emerging impression of the trustworthiness of the content is constructed by a combination of following the scholarly conventions of publication and expressing a recognised publication sponsorship as a point of reference (i.e. affiliation to a university department or a research institute, and an esteemed publisher) [832].

4. *Infrastructure*: Even though the informants tended to emphasise the importance of an individual judgement with each individual document, e.g. the general comments on the unreliability of the Internet information versus the information attained from the conventional scholarly sources, the prominence of some journals and series over the others and the trustworthiness of private

[13] Some preliminary theoretical observations on the peer-to-peer networks in archaeology ref. [573].

> communication, indicate the importance of the cognitive authority, which is maintained by the used infrastructure. The significance of the information systems and infrastructures based trust has been acknowledged in the literature (e.g. [24, 19][392]). Broadly speaking, the primary benefit of the infrastructural trust may be traced to its economy. If an infrastructure is considered to be trustworthy, its contents are automatically trustworthy. It is important that the infrastructure provides means for confirming the infrastructural trust with a factual trust by offering a mechanism for verifying the provenance and authenticity of the content (ref. e.g. [310]). The principal problem, which is related to the verification mechanisms is that these tools are used rather seldom. This leads easily to the repetition and quantification of errors. Therefore, as Chapman underlines, it is especially important to be able to ensure the integrity of the information, which is stored in the infrastructures [153].

Considering the role of the personal scholarly judgements and the social verification of knowledge, the responses were well in line with the expectations. The derived critical comments on the intellectual authority of an establishment were deliberately provoked in the interview (ref. Question 5, Section "Characteristics of information need" in Appendix B) to reveal more information about the dynamics between the vertical and horizontal networks and their interplay with the apparent intellectual expectations to rely on the scholarly and scientific codes of conduct in the information work.

The notions of trust and cognitive authority appear to build on two cornerstones in the archaeological discourse. The constituency of both *personally and socially discernible contexts* (contexts 1 and 2, see above), and *infrastructural contexts* (contexts 3 and 4) characteristics are transparent. The infrastructural characteristics coincide with the social sphere within the scope of publisher sponsorship [832] and through the social formation of the infrastructures. The both contexts are, however, maintained as autonomous denominators of the cognitive authority. The infrastructures are dependent on the social and personal contexts, but still function as if they were independent.

Andersen emphasises scientific documents as devices for articulating the authority. The essence of the social influence resides in the cycle of reaching for novel knowledge claims (i.e. research results) and thereafter convincing the colleagues of their actuality [24, 19]. Scholarly literature is clearly functioning in a mediating role between the organisation of knowledge and the organisation of the social spheres in archaeology. In contrast to the standpoint of Andersen [24], the scholarly literature is, however, difficult to accept as being the fundamental mediating link between different actors in the domain of archaeology. According to the findings of the present study, the role of literature seems to reside primarily in the formal maintenance of the linkage. A considerable portion of the mediation seems to function directly within the combined community of practitioners and academic archaeologists. The meticulous organisation of the authority relations in terms of social relations seems to relate to the constituency of the comparative information work in archaeology. The activity of seeking and using information to find out similar and dissimilar comparisons of sites, materials and activities is of a considerable significance for the justification of the results in archaeology. The value of the information work builds on the process of making comparisons to the predecessors and the contemporary colleagues, rather than on the notion of presenting exact observations or producing impressive results out of the social, societal and cultural contexts.

For the present study, the significance of the notion of cognitive and affective authority is in its capability of making the infrastructural and the social and cognitive frameworks of the information work processes explicit. Experiencing authority is a personal, inter-personal and infrastructural phenomenon with a strong communal, cultural and affective basis. It is a key component of any information work process as a contributor to the perceived relevance of the information objects and the roles, procedures, purposes, meanings and values of the information work, and the organisation of knowledge.

7.5.4 Ecology of the information process

An information process is a life-world wide phenomenon. The processes are related to the work and work roles performed by individuals, which are for their part deeply rooted in the contexts and situations of the life around. Information process is in a cross-draugth of the authority relations and the political nature of the information and knowledge. While the work related individual interactions are warranted by the requirements and expectations of the work roles, the choice between the competing alternatives and their outcomes is afforded and constrained by a far wider spectrum of individual, social and cultural issues.

The life of the archaeological information process resembles an ecological continuum. The diverse beginnings, progresses and outcomes of a process are afforded and constrained from the systems point of view by the infrastructural factors within the relevant situations and contexts (Section 2.6.3). The process is repeating itself iteratively being both aware and unaware of its earlier iterations. The archaeologists return again and again to the primary materials to uncover new information, which is needed to address the new questions emerging from new information and theoretical viewpoints. A lot of work is also conducted to re-establish partially documented authority information and only to come up with precisely the same conclusions than earlier due to the lack of appropriate mid-level information infrastructures such as reference works (for parallel see [704]), databases and compendia.

The archaeological information is political. The information is contested and its implications are always a matter of debate. The political preferences function as further affordances, constraints and warrants for the ecology of the information process. Even if an information and its organisation is warranted in some situations and contexts, they are bound to be controversial in some others.

An information process is movement from a starting point to a conclusion, and movement further towards another conclusion. The process is not stable at any moment of its existence. Still, the process presumes a degree of stability in the form of an internal coherence. The process needs to explain itself to the involved human-beings. Instability is caused by the alteration of participants and their altering behaviours, the changing situations and the fluidity of contexts, which turn the process and the involved information and knowledge to political notions. The coherence is reclaimed and regained, and subsequently warranted by the dynamics of the emergence and decline of the authorities.

The coherence, which is achieved during the process, is a measure of its reliability. Simultaneously it is a measure of the ecological legitimacy and viability of the knowledge. The sources of the legitimacy do vary. A source might be a formal reference to the literature, a social warrant provided by a trusted colleague or organisation, or a complex combination of individual positive referential cues. The quintessential factor is, however, that the knowledge becomes actual (ref. poten-

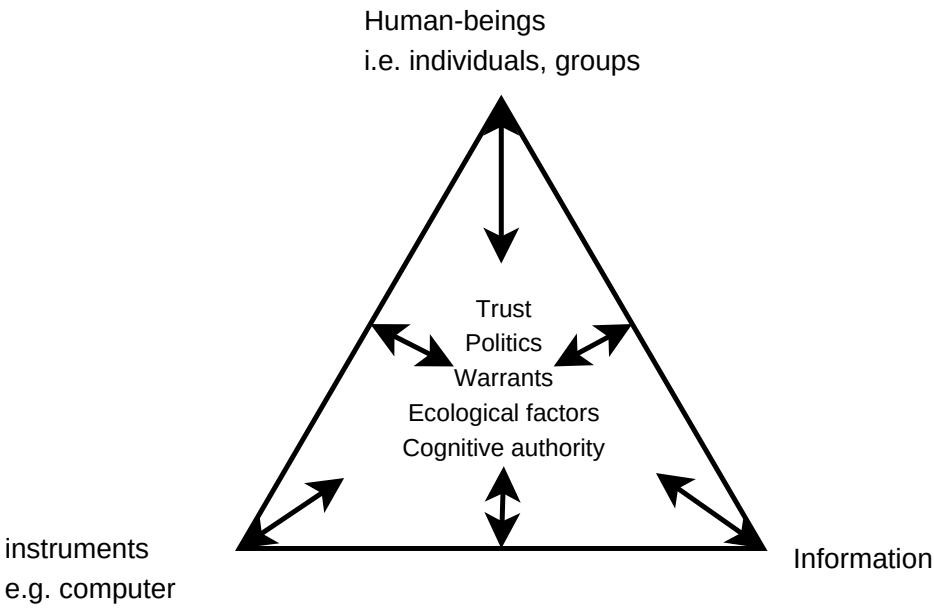


Figure 7.12: Ecology of the archaeological information process

tial - actual in Section 3.2.1) only after its legitimation. In a constructionist sense, the knowledge becomes first constructed as a meaningful knowledge only after it becomes warranted and it reaches a satisfactory state of coherence.

The notion of coherence and its relation to the human information interactions has been discussed principally within the scope of information discovery and everyday life information seeking and use discussions [229][154][460][155][704][707] [706][250]. An important distinctive aspect of the information work based approach is its situatedness within the wider horizon of information and the processes of seeking meaning and making sense of the surrounding life-world. The sense of coherence, which is attained by the process of seeking meaning denotes an understanding of the dynamics and the being of these whereabouts of information and life-world. The sense of coherence is constructed and maintained by the individual and shared experiences of the life-world, the work, information work and information processes together.

The effects of the warrants, the ecological notions of affordances and constraints, and the social and cognitive issues of the politics, authority and trust may be illustrated in the triangle of the information viewpoint (Fig. 2.2). They are factors, which emerge from the information, human actors, and instruments and impinge their mutual relations in a manner, which is illustrated in the figure 7.12. The factors do also determine the functioning of the notions of work and information work in the overall model of the work in context, where the human beings are represented by the notions of actors and behaviours and the system of instruments and information reside in the axis of the information and work horizons (Fig. 2.6). The factors discussed in the present study do not represent naturally more than a small portion of all the strands, which make information processes and their ecologies, but they do still comprise some of the essential issues of archaeological information work at the present.

In conclusion, the constituent aspects of the archaeological information processes centre around the effort of the maintenance of the coherence and interoperability in the middle of the changing situations and contexts, the politics of archaeology and of the archaeological knowledge, and the struggle for authority. The information interactions turn in the convergence of the determinants to a complex interlinked network of human life, far beyond a simple notion of 'working with information'.

7.6 Critical success factors in archaeological information work

The success of the archaeological information work relies on the convergence of a variety of factors. In spite of the general complexity of the phenomenon, certain factors do clearly have a more profound effect on the fortunes of the work and information work, than some others. The idea of analysing critical success factors (CSF) is based on that particular observation. The analysis of the success factors and the later developed Critical Success Factor method has been a widely used approach in the information management research starting from an influential article by Daniel in 1961 [209]. The approach was later elaborated and made popular by Rockart [630] and used by, for instance, Ginman [318][319], de Heer [358] and Widén-Wulff [827][828]. CSF method is also a part of the Strategic Information Management (SIM) methodology [838] developed by Wilson and used, for instance, by Huotari [393].

The discussion of the findings of the present study and especially the observations on the pertinence of change, transience of authority, adequacy, fitness and appropriateness have a deep effects on the dynamics of archaeological information work. They provoke a proposition that the critical success factors of the archaeological information work may be collated in the notions of *fit* and *sustainability*. Besides mastering the practical characteristics of the work and information work process, the informants were feeling coherent about the precise work they were personally involved in. The major issues and the consequent critique was pointed towards the frame of the archaeological work (i.e. resources etc., see Section 5.4) and of the related information work (e.g. the issues of findability and usability of information, ref. Section 7.5).

The notion of 'fit' grasps the various interfaces between the work roles, information behaviours, levels of complexities, interactions, and the human and non-human components of the information work systems. 'Sustainability' is concerned with the constituency of the temporal dimension. The relevant timespan of archaeology covers essentially an indefinite time from the beginning of the humanity until its end. The issue of time affects not only the scope of the information acquisition and preservation, but also the sustainability of the archaeological work and archaeological information work, its purposes, meanings and values. The two success factors are discussed in detail in the following two sections.

7.6.1 Fit

The problem of reaching a series of propitious fits in archaeology is a question of finding appropriate means to communicate between the different stakeholders operating in significantly different contexts and of referring to strikingly different

conceptions of work. The notion covers not only the gap between past human beings and the present community of the archaeologists (which is a scholarly issue of archaeology), but also the information management issue of bridging the gap between the different work roles and notions of work within the community of archaeologists.

The essential characteristic of the archaeological information process relates to the way how the customer and participant behaviours relate to the process of information work: how problems are solved and how the information interactions perform in the process. The fit requires sensibility both from the part of the user and the provider. Almost all archaeology related interactions require a similar sense of knowing beforehand where to go, to make an appropriate move, as the submarine chasers [561]. A hunch or an instinct and the subsequent behaviour is based on a complex preunderstanding of the work horizon and the related information horizons. The difference between the submarine chasing scenario and the community of archaeologists is that the past is not deliberately avoiding an archaeologist.

The archaeological information process is embedded in a matrix formed by the individual archaeologists, the community of archaeologists, material remains of the human past and the societal and cultural perception of the past and its relevance and meaning. The public interest and a popular need to orient oneself in the context of a personal past has a vague and difficult to determine, but still influential, effect on the process. The different contextual levels of archaeology, including the wealth of discourses from global to the local, and from the societal to the academic and cultural ones, provide similar definite, yet intangible influences. The analysis of the epistemic questions, research objectives, social considerations (such as the reputation building within the frame of the information activities), is equally important in a domain specific investigation of the information activities, as Fry observes [295].

The individual information processes of the interviewees varied considerably due to a number of facts, which range from the personal preferences to the organisational conventions. The core of an archaeological information process seems to be, however, possible to reduce to the activity of 'elaboration', which is based on an entity of archaeological material. Fundamentally, the process attempts to create meaning for the discussed material in a complex process of conceiving, nurturing and perfecting a network of relations. The relations function through comparative arguments and parallels, which support a scholarly claim. The assertions of the value and relevance of the construed argument, are strongly dependent on the (social) context of the archaeological work. Similarly to the formation of the relations, the outlook of the work of mapping the parallels, correlates with the generic information source behaviour of the individuals.

It would be intriguing to argue that the human issues are the focal success factors of the archaeological information work. To an extent that is the case. Therefore, the personal connections should be kept in mind when interfacing the human systems with the technical ones [131]. The observation of the general enthusiasm among the interviewed on the emerging possibilities offered by the digitalisation, is clearly consequential. Even if the informants' tendency to satisfice the interviewer might explain part of the optimism, the trend is still quite clear. The consequential implication indicates an immanent need to empower archaeological information management and may be taken as a basically positive and receptive attitude towards new implementations, if the implementations might be expected to actually empower the work of the individuals from their personal point of view. The frequent critique towards the already existing new systems indicate, however,

that each individual defines her precise understanding of the archaeological information work and the means how to reach the common goals. The interviewees graded such systems highest, which were developed close to them, and which were implemented by someone, they knew personally before. The large information systems maintained and implemented by national and foreign organisations, were subjected to the heaviest critique.

A part of the expressed doubts are plausibly explained by the classical notion of the organisatory inclination to resist change [489]. The dissatisfaction to the distant systems and the higher satisfaction to the local systems is partly explained by the fact that a local system may be designed to meet very special local needs and desires. On the other hand, the assumed unfamiliar conventions and the various motivations, which guide the system development, might be explained more thoroughly to the users. A substantial part of the critique of the 'large' systems may not, however, be directly explained by the effects of the origin and distance of the straightforward interventions to the routines of the individuals. A part of the critique seems to take the form of philosophical arguments, which legitimise the local patterns of work, but the findings do show rather clearly that the incompatibilities also penetrate to the level of substantial differences in the contexts and practises of the archaeological work, and consequentially, of the information work. The doubts and the eventual resistance might be better explained by referring to a distance between the contexts of adoption, which is complemented by an inbuilt latency of a structure (here the 'work') to integrate new instruments. The latency becomes expressed by a reluctance to adopt (perceivably) marginally better procedures or systems to replace the existing and tolerably functional ones.

A significant issue of the archaeological information management may be traced to the inconsistency of the information organisation and its subsequent usage patterns. The organisation of the information objects into larger collections, follow the principle of provenance, which is a central concept in the archival science [C, D, I, J, O, P, V, W] (also [231, 176-177]). From the collection accumulation and creation point of view, the principle is well founded. Comparably to the archival data, where the provenance typically refers to the organisations, in archaeology, the principle enhances the possibilities to contextualise individual pieces of data to their spatially close entities.

The overall information process is formed relatively well to serve the purposes of documentation, archival, and to a degree, the primary administrative needs of the cultural heritage management bodies. The architecture and ecology of the resulted records support relatively poorly the practical needs of research and the public dissemination, because the documentation tends to be focussed on technical details rather than on capturing contextual information and providing efficient means to address any cross-site issues. Gardin pointed out this peculiarity already in the era of printed catalogues long before the present debate [300, 8]. The provenience principle and the essentially cataloguing (rather than use) oriented viewpoint to the entering of the data, constrain the practical possibilities of performing intersite analyses and studying the data according to some other organisation principle than the one of a site and its spatial location.

The loosening fit between the documentation and its usability may be explained partly by a lack of adequate information management and management of information work, but it also reflects a disparity between the professional and academic archaeologies (Section 5.3). The antiquarian traditions of archaeology seem to have persisted in the documentation, while the scholarly research has adopted new the-

oretical frameworks. Secondly, the professionalisation of the non-academic archaeology has differentiated the practical documentation process from the scholarly information needs. According to the informants, the documentation process is motivated by the prospective efficiency of field documentation and the recording of the "absolutely necessary" details on the location [D, J]. The demands for efficiency and accountability have curtailed the room for a scholarly cogitation in the process. The question of increased detail and its practical extents is fundamentally a political issues, because the generation of a more comprehensive documentation demands necessarily more resources. At the present it is evident, that the subsequent utilisation of the documentation is based in many instances on a previously acquired personal familiarity with the site and the project, social contacts and personal communication with the colleagues, accidental discovery of contextual and comparative information, and in any event, on a comprehensive effort and use of time.

7.6.2 Sustainability

The sustainability is in many ways a critical issue for archaeology. In the sense of the preservation and conservation of the materials, sites and monuments, it is prominent around the world. The issue concerns the physical endurance of the monuments and the economic sustainability of the maintenance work. The physical and economic sustainability of the entire cultural heritage sector has attracted considerable attention in the recent academic studies and administrative initiatives [285]. The endangered condition of the world's cultural heritage is becoming increasingly apparent. Simultaneously the notion of cultural heritage, which merits preservation, is broadening and the amount of relevant information on the assets is exploding [778][506][124]. Strategies to manage the vast sets of data [819], sustainable economic models [204] and even re-engineering of the cultural heritage business processes [529] are undoubtedly needed.

The management of the archaeological secondary information is faced by the same problem. The sustainability is an issue, which is also related to the work itself. The labour (ref. Section 2.5.1), which is embedded in the work, needs to be sustainable so that the pursuits are feasible and practicable in the economic, physical and societal senses. The conceptualisation, understanding and valuation of archaeology are bound to change over time. Despite the changes, the archaeological work and information do have to converge in a feasible manner also in the long run. Maintaining and working for the compatibility is not, however, a straightforward matter. Present requirements for a theoretical backward compatibility of the documentation and the subsequent, relatively slow evolution of the archival standards do cause complications for the documentation and post-excavation work.

Beyond the extents of the information, materials and work, archaeology needs to be tenable for the community of archaeologists also in a cognitive, affective, social and cultural sense. On the level of individual archaeologists, the sustainability relates to their personal and social stability and perpetuity. The coherence of the reputation, meaning, purposes, values and estimations needs to be sustainable so that the professional and scholarly community continues to function as a carrier of the intrinsic and broader societal purposes, meanings, and values of the archaeological work. The communal sustainability contributes directly to the tenability of the work practises and tacit information processes. The continuance of what is being done and what is known, is essential for maintaining the inertia of informa-

tion and knowledge in the domain. An administrator employed in a permanent position, remarked that the expertise of the project staff is difficult or impossible to utilise outside the distinct projects because of the tightly allocated funding. Similarly, the short contracts cause a danger of loosing valuable expert knowledge, when people switch jobs frequently and often end up in a permanent position outside archaeology for purely practical reasons [C].

The community of archaeologists relies on the notion of being and working together as teams, where everyone knows everyone. The inertia between the teams and the individual people beyond the level of direct acquaintance requires a complementary system of communal organisation. The system affects necessarily the procedures of work and information work and may be expected to cause peculiar interferences to the explicit rationale of the processes.

The enterprise of the archaeological work and information work reflects the conceptualisation of the intellectual and social organisation of the sciences proposed by Whitley [821]. The seeming anomalies of the process, which suggest an incomplete and inefficient match between the information production, provision and use are not necessarily anomalies at all. These inconsistencies may be largely explained by the maintenance of the reputations. Besides the outspoken societal and technical objectives of the archaeological research, the value of archaeology for the community of archaeologists, is in the maintenance and development of the personal reputations. The reputational framework is not necessarily a reason why things are done, but it is a social enterprise within the system of work, which clearly affects the ways how things are perceived and what is emphasised in the process of the making of the things.

All of the archaeological work does not directly qualify as the specific type of scientific work discussed by Whitley. The collegial system affects deepest the work roles of academic research and fieldwork, but carries an impact on all work as far as it concerns interpretations and statements on any objects or methods of archaeological interest. An administrator who makes a doubtful decision on the preservation of a site of a potential archaeological interest tends to become criticised, even if the collegial control was somewhat weaker, as it is in case of the non-university state-funded posts for the public science in Whitley's framework [821, 66-67]. Similarly, an educator who presents controversial interpretations based on some archaeological material, endangers her reputation. This observation does as such, underline the assumed inclination to discuss about archaeologists as one community in spite of the significant differences between the work roles. A further implication of the notion is that the archaeological profession is situated between the Whitleyan notion of sciences and the professional work communities. An archaeologist is in her work roles simultaneously a researcher and a practitioner.

Archaeological claims become challenged within the system of reputations in all archaeology work roles, even if the technical skills and capabilities of an archaeologist may remain relatively unchallenged if the individual is in the community agreed to be formally competent. The informants who had functioned in the field archaeology work role, made a clear distinction between themselves and the others who had no field work experience. At the same time, the interviewees made no remarks on any eventual differences in the competency of the individuals within the field archaeology work role. The excavations of the early archaeologists from the 18th to the early 20th centuries could be criticised of lacking precision. On the more recent projects, the professional work becomes less likely challenged, while the interpretations and the conclusions (i.e. the scholarly reasoning) becomes heav-

ily debated.

The importance of a collegial approval throughout the scientific publication system carries a deep impact on the archived and published results, interpretations and materials. Archaeologist have to stay visible through producing noteworthy output. Concurrently, within the relatively small community of professional archaeologists, it is often far more important not to attract negative attention than to be known of an occasionally somewhat insignificant, but formally correct output. A complete fake may lead to a publication, but is "unlikely to lead to a glory" [821, 23]. A similar balance impact is visible in the policy decisions related to the archaeological heritage, its preservation and display. The past and the entire notion of cultural heritage may be perceived as an educated consensus of the professionals and the general public. The archaeologists and the public share its ownership, including the rights and the responsibility for its reading and conservation. The different parties of interests, including the heritage conservation and the community development, need output to advance their needs. The existing views become challenged all the time, but as in the scientific communication, the most radical, and from the scholarly community point of view, entirely spurious views, tend to become neglected.

Considering the broad scope of the concept 'sustainability', it shows interesting convergence with the notion of coherence in the technical sense of storing information. Besides the technical sustainability, it is also referring to the broad mastery of the personal and communal life-worlds [229][154][155][706][250]. In a technical sense, the archaeological work and the information work have to be sustainable in order that the finds, artefacts, sites and monuments might sustain to the future generations. In societal sense it is critical that the archaeological work and information work maintain their internal and external coherence to maintain the purposiveness, meaning and value of archaeology within the community of archaeologists and for the society, where the archaeological work is being done. In conclusion, it seems that the most critical aspect of the sustainability success factor is that the sustainability penetrates the level of technical preservation and reaches to grasp the organisation of the archaeological work.

7.7 Summary

The present chapter discusses archaeological information work with a special emphasis on the information sources, horizons, information behaviours and the information process. The findings indicate that the archaeologists use a broad repertoire of information sources in the different phases of the archaeological work. The role of the archaeological materials becomes especially emphasised both as an information resource, but also as a focal point of the information interactions. In the context of the present study, the work roles are significant indicators of the information source use and especially of the layout of the information horizons.

The information behaviours of the informants were classified into four categories of intensive and extensive participants and customers according to the depth and reciprocity of the information interactions. Information behaviours are primary indications of the personal information habits, but they are also significantly related to the individuals' work roles.

The discussion of the information interactions indicated the predominance of the following factors in the archaeological information work:

1. The constituency of situatedness and contextuality of information
2. The political nature of archaeological knowledge
3. The intricacy of the functioning and formation of authority and trust relationships in the archaeological information work

The ecology of the archaeological information process was discussed in terms of authority issues, the archaeological information life-cycle, and the contextuality and situatedness of the process. These essentially ecological factors, which dominate the human-instrument-information relationship, were summarised in figure 7.12.

The analysis of the information work was concluded by identifying two critical success factors of the archaeological work and information work: *fit* (broadly understood as a contextual compatibility within the work and information work) and *sustainability* (the coherence, endurance and manageability of the process of work, not only of archaeological information and information storages). The emphasis of the success factors is on the maintenance and management of cross-contextuality in the present instances of information work process and in ensuring that the acquired level of fit between the information and its users endures over time.

Chapter 8

Knowledge and virtual realities in archaeology

The following chapter discusses the interfaces between archaeology and knowledge, and between archaeology and virtual realities. The discussion builds on the understanding of the archaeological work explicated in the previous chapters (Chapters 6 and 7) and sets to explicate its congruences with knowledge and information infrastructures.

The first section sifts through the fundamentals of archaeological knowledge by examining the resonance of the archaeological record, evidence and interpretations in the archaeological information work. The second section brings the archaeological knowledge together with the critical success factors of the archaeological information process (Section 7.6) in order to explicate the premises of successful knowledge organisation in archaeological contexts. The factors are discussed further with a reference to the potential qualities of the virtual realities as knowledge organisation systems. Finally, the notions of archaeological knowledge, information work and virtual reality are brought together within an ecological framework, which provides an integrated perspective to the concepts of information work, knowledge organisation and virtual realities, their interfaces and mutual interactions.

8.1 Knowledge in archaeology

Archaeological knowledge is knowledge about the past, which conforms with the epistemological framework of the archaeological scholarship. The present study has pointed out so far that the notions of 'using information' and 'formulating knowledge' are significantly complex issues in the context of archaeology. The knowledge formation rests on the individual human-actors, their assumed work roles, politics of the archaeological and cultural heritage, trust and the cognitive authority, and on their surrounding social and cultural situations and contexts. Even in its most concise forms, the archaeological information is a very fluid interface between the past and the present.

The following section relates the findings of the current study to the earlier discussion of the nature of the archaeological information, knowledge, descriptions and interpretations, which may be found in the literature. The purpose of the section is to contextualise and deepen the understanding of the purposes, meanings

and values, which are associated to the archaeological information work, in order to establish a thorough cognisance of the object of knowledge organisation in the domain of archaeology.

8.1.1 The nature of archaeological record

Archaeologists use the term *archaeological record* to denote "the physical remains and associated information about those remains, including those located under water" [461]. The description functions well in a technical sense. Its essential meaning (expressed in diverse wordings) was also sufficient for the informants of the present study. This basic understanding of the 'record' is adequate for explicating the relationship between an archaeologist and the objectives of the archaeological work [A-Z]. In information work and knowledge organisation contexts it is, however, necessary to establish a more thorough and epistemologically grounded understanding of the concept. From the archaeological point of view, the question of the nature of archaeological information is essentially a question of conceptualising the relation between the corpus of known material remnants and the past, and defining the role of an archaeologist in the particular process of constructing this relation [198]. From the information point of view, the question extends to embrace a more specific explication of the role of information in the process.

Like the humanities scholars (and unlike the natural scientists) in earlier studies, the archaeologists interviewed for the present study did not ascribe a uniform notion of the object of their study (e.g. [414]). In this respect, there is no universal answer to the question of the nature of the archaeological record, like there is no precise answer to the question of what is 'archaeological data' (ref. [51, 8-9]). Patrik defines two fundamentally contrasting ways to perceive the archaeological record: a physical and a textual model [578, 29-31] of conceptualisation. The *physical model* is exemplified by the two major paradigms, the 'cultural-historical' and 'processual' archaeologies, which have been[1] prevalent in the scholarly discourse. The 'cultural-historical' archaeology was the major paradigm until the 1960's, when the new archaeology was first introduced and began to gain ground. The physical model represents a clearly objectifying standpoint. The archaeological record is seen essentially as a static result of past causes [578, 11-17][421, 11-17]. The textual model of conceptualisation relates closely to the post-processual movement in archaeology, which emerged in the early 1980's. The notion of perceiving the archaeological record as a representation of the past, has its roots in the structural linguistics and especially in the works of Barthes and Ricoeur [421, 17-20].

The static notions of archaeological record has been recognised as being problematic. The basic principles of archaeological stratigraphy (i.e. the study of stratification and the subsequent interpretation of the archaeological record) are based on the notions of a relatively transient process of depositing and a static preservation of the stratification thereafter [423, 150-156]. The importance of identifying the effects of various formation processes and of distinguishing between the primary and secondary contexts (i.e. whether the layer has been disturbed after being deposited) has been acknowledged, but the identification has proven to be significantly difficult. The most of the post-depositional processes are considerably hard to discern and interpret. Even if the investigated record would be directly equivalent to its state at the moment of deposition, its constancy would be very difficult to discern [O, P, V, M] (ref. also [352][360][752] [144]).

[1] Also known as the 'new archaeology', ref. e.g. [777, 351-361].

Essentially, the question of the relation between the record and the past, is a question of different views on the exact nature of the archaeological record. In the physical model of interpreting the archaeological record, the correlations are seldom strong or direct enough for establishing straight correlations between the various pieces of evidence and past phenomena. The relations are typically indirect and they are subsequently giving indirect grounds for the propositions of a possible correlation [423, 150-156][616, 100]. In conclusion, the practical consensus of the informants, which is also reflected in the methodological literature, is that the archaeological record is an *indication* of the past state of affairs. Its precise nature is depending on the situation and context of the deposition, its preservation, the investigation and interpretation. But still, in spite of its deficiencies, the archaeological record is the best corpus of available evidence for drawing conclusions on past human activities.

8.1.2 Description of archaeological evidence

The notion of *archaeological evidence* refers to all objects of a primary archaeological interest. The evidence may denote any kind of material of archaeological interest such as small finds, artefacts, sites, organic and environmental remains and groupings such as structures, features and regions [616, 45-46]. The problems of describing and documenting the evidence in a unified manner have been for a long time, an acknowledged issue within the community of the archaeologists (e.g.[75][777, 458-459][83][812]).

Archaeological evidence is catalogued and described according to its physical characteristics [A-Z] [616, 103-108][423, 200-204, 227-243]. The approach could be criticised of a positivist standpoint. The description implies an objectivity of the physical appearance of the evidence. The informants acknowledged the evident lackings of the physical descriptions, but tended to think that in spite of the inadequacies, it was still the thing to be done [e.g. B, C, I, V, N]. The documentation approach and especially its practical implementation has its historical origins in the objectifying scientific paradigm as well as in the artefact-centric archaeological paradigm of the 19th and early 20th centuries.

Although the method of describing or coding the archaeological evidence may be explained by paradigmatic notions, the descriptions, which are centred around the physical characteristics, could be also reflected against the pragmatic foundations of the archaeological basic research (Section 7.4). The analysis of the information interactions indicated the constituency of the appropriateness obstacle in the most of the information interactions. Due to the contextual variation of terminology and descriptions, the physical characteristics are often assumed for the reasons of work economy as the smallest common denominator. Considering the present analysis of the archaeological work, it is rather questionable, however, whether this approach is a sound one, because it impedes the subsequent information work in all sectors of archaeological profession.

The general observation of the ambiguity of the terminology in the humanities research made by Tibbo [773], applies also to archaeology. The archaeological record and information on the record, are highly contextual notions. The value of descriptions and codings as information, depends on multiple factors, which make the actual work of assigning the codes extremely difficult [140]. In a sense, a documentation is a system of signs [629]. In a system of signs, 1) one subject may be described using two different terms, 2) similar terms may, or may not, co-exist in

related contexts, and 3) a single term may, or may not, refer to two similar concepts. In spite of the excellent and, for many purposes, satisfactory and workable efforts of constructing controlled vocabularies and conceptual models (e.g. [404] and [199], [219] and [689]), these efforts have not managed to solve the problems. The accumulation of ambiguity has reduced the objectives of the descriptions to serve the purposes of recognition and identification instead of actually giving elaborate delineations (e.g. [382]). Still as Eriksdotter emphasises, the archaeological documentation work needs to be technical and to concentrate on details during the fieldwork period, in order to capture as much essential subtleties as possible. If, and only if, the documentation work is done in detail, it is possible to make any educated identifications and recognitions thereafter [255, 103].

The archaeologist who originally made the documentation, is necessarily in a position to be able to make most out of the material, because only she has the physical context as complete as it is ever going to be. New research methods and new comparative materials are capable of preserving the relevance of the old materials. A process of an 'impoverishment' of the interpretations (i.e. further interpretations are based more and more on the details found in the secondary publications instead of on the entirety of the original context) is likely to be typical to all scholarly sciences, but it is especially significant to the archaeology, where the contexts are notably scarce (ref. [H]). The notion of contextuality becomes especially immanent when a restricted and heterogeneous corpus of material is stretched to its explanatory limits. The material remains are used to provide means to understand the motivations and mentalities behind the actions. In many other contexts, a comparable amount and type of information would be most likely judged to be inadequate for such interpretations. In archaeology, the researcher has no choice, because there is no other evidence.

Wiberley noticed the importance of the proper names, and temporal and spatial terminology for the humanities researchers [823] (ref. also [773]). The spatial and temporal terminology, and the geographical proper names are also highly relevant for the archaeologists, and as such they are frequently utilised as key words and terms [D, E, F, I, J, N, U, W, X]. A necessary unification of the terminology within an individual project, is achieved in discussions, directly asking the project director to determine a proper descriptor [A, M, O, Q, W] and, to a degree, by referring to authoritative sources [A, Q, V] such as comprehensive doctoral dissertations or monographs published on the particular special subject. In spite of the frequent mentions of their usefulness, the 'authoritative sources' function mostly as rather *ad hoc* -type points of reference. Lange has proposed a European wide reference collection of archaeological information as a remedy to the issue of scatter and the consequent unavailability of references [464]. It would be an interesting, but immense project, which would undoubtedly face the problems of scale, integrity, sustainability and management.

Applicable term lists and dictionaries exist only in some special fields of archaeology [A], such as on the general nautical terminology, which is relevant to the maritime archaeology. The significance of the proper names (besides the temporal and spatial terms), indicates the importance of stable contexts in the middle of the heterogeneity of viewpoints and in the consequential lack of an extensive standard terminology for the entire domain. Attempts have been made, and are being made, to attain universal archaeological classifications and ontologies (e.g. [852][677][219]). The classifications and ontologies tend to be based on the notion of making the organisation universally accepted through consensual political deci-

sions, which effectively limits their applicability within the confines of small specialised domains.

The classification of archaeological objects shares many difficulties with the classification and description of visual arts objects [773]. There is only some further complications. In a catalogue of arts, one relevant viewpoint to each object, is to perceive it as an 'object of art'. In an archaeological collection, the value and meaning of the objects do not have a similar given standard functional frame of reference. An object and its meaning resembles more an event in the spirit of avant-garde and post-structuralism. When the archaeological information is discussed in a strict sense, an object does not epitomise a "timeless" value of a 'museum artefact' or an 'object of art' [217]. Understanding an archaeological object, its significance and meaning requires always a careful and difficult mediation between the object, its possible contexts of reference, and the interpreter (ref. [48]). Following the notion of Shanks, the understanding of an artefact is a construct, which is different from the past idea, yet as intended, it is closely resembling the original [682, 7-16].

As a consequence to the lack of universal classifications and ontologies, the prevailing factor, which defines the information and knowledge related orientation in archaeology, is the affiliation to a specific research theme or domain. These external themes may consequently support the archaeological work, by their internal ontologies and classifications (ref. [528]). Even if the everyday work duties do not necessarily include (academic) research, the identity of archaeology and individual archaeologists is constructed, to a recognisably large extent, on the basis of research oriented categorisations. The archaeological themes and the process of self-identification of the interviewees seemed to orient routinely on the basis of the source material, geography and periodisation, whereas the theoretical or methodological professions were conspicuously avoided by most of the informants (ref. Question 8, Section "Interaction with the past " in the Appendix B). The informants were more inclined to state that they were focussed on the pre-historical archaeology, maritime archaeology or Asian archaeology instead of post-processualism or archaeological field research. The formation of the categories of interest, such as the medieval pottery, stone age bone material or medieval shipbuilding techniques, is also attributable to the history of the archaeological thought. The earlier theoretical tendencies perceived the objective of the archaeological work through such thematic typologies. The tendency does no indicate of an overall negation of the methods, viewpoints or theories, because the different materials, periods and environments do require different theoretical and methodological considerations. Neither does it negate the apparent usefulness of such a categorisation. It seems, however, that the explication, which seems to be characterised by a degree of pragmatism, has consciously retained to a 'neutral' and 'acceptable' expression by referring to seemingly concrete categories. It seems that the manner of discussing of archaeology in the terms of materials and periods is more acceptable, understandable, and in a sense more esteemed, than focussing on research problems or theoretical frameworks.

8.1.3 Archaeological interpretations

According to the prevailing post-processual theory, archaeology is a relativist scholarly discipline, not an experimental objectivist science [682, 103][775][385]. Archaeological knowledge is emerged from archaeological material in an act of interpretation and explanation. The emphasis of interpretations and an assumed inter-

pretative and constructive sense of scholarship is not an entirely trouble-free position. The strong emphasis of the interpretation leads easily to an extreme relativism and a type of nihilism, which disputes the meaning of archaeological material and knowledge. Wylie underlines the necessity of cognisising the value of *plausible truths* while attempting to reach a working resolution to the meta-physical anxiety of 'being able to know' and 'not being able to know' [848]. Assuming a slightly opposite perspective, Criado argues (assuming a 'post-interpretativist' standpoint) that there should be a limit for extending the chain of interpretation. The proposals of 'limited objectivism' and 'limited interpretativism' (or post-interpretativism) come to a similar conclusion of the significance of the *practical* status of the knowledge claims. The data and information are theoretical appropriations of the archaeological record and they exist in proportionate autonomy of each other [494, 3]. The adherence to the economy of methods, phenomenological intuition, acknowledgement of the social theories, cultural rationalism or to a limited material determinism, do not necessarily imply of a complete refusal of the interpretativism [198], nor does the opposite approach suggest the refusal of a 'truth' as far as it refers to a matter of consensus.

In spite of the scale of the assumed relativism, an interpretation is not a mere translation**.** Díaz-Kommonen points out some similarities between the archaeological knowledge formation and design. The past is something, which has to be sought for and the continuance between the individual remains has to be actively constructed (cf. manipulated, ref. [54]). Post-positivist history and archaeology acknowledge the significance of the argument that history is not merely interpretation, but it is construction made at the present [G, H, V, Z] (ref. also [231, 22-26]). The act of surveying, excavating and documenting is, in a sense, an act of 'construction' and creation of the archaeological material. Díaz-Kommonen makes an important point by asking where the archaeology ends when past is moulded into digital (or analogous) (re)presentations, which are fundamentally newly 'designed' artefacts [231, 26]. The observation of the similarities between the archaeological and design activities, is important and contributes to the understanding of the knowledge formation processes in both the fields.

The essential difference between the two approaches of archaeology and design is in the divergence of the basic assumptions on the meanings, values and purposes of the work. In spite of its objective of understanding past human activity, archaeology is more interested in the building blocks (i.e. the primary material), while design is focussed on the final object. Consequently, an archaeologist is basically satisfied with a negative result (e.g. a set of materials may not be used to ground some specific kind of interpretation [C, W]). A designer, on the other hand, is specifically oriented to the completion of a result (e.g. an object, a new process or an innovation [231, 131, 239]), whilst the perusal of the existing matters remains as an activity of secondary importance. The comparison of design and archaeology opens interesting perspectives to the role of objects in both disciplines. From the archaeological information work point of view, the most significant difference between the two disciplines is their fundamentally contrastive ways of perceiving an 'object'. Even if the explicit purpose of an archaeologist and a designer would be to show that how an object looked like in the past, the contrasting viewpoints make their eventual cooperation very difficult. The relevance of underlining this contrast is to emphasise the need to pay a close attention to the effects of the purposes, meanings and values of work and their dynamics with the related actors and material objects. Even if the technical procedure of treating material objects in two

different disciplines would be closely similar, the differences in the work may necessitate that the relevant information infrastructures and instruments need to be completely different.

Another issue, which distinguishes archaeological construction from a design construction, is the difference between the meaning of documentation and interpretation. In archaeology, distinguishing the two activities is difficult. Documentation involves always a substantial amount of constructive interpretation ([C, D, F, M, O, V, X] cf. [231, 115]). Therefore, the notion of using archaeological documentation as a raw basis of 'design' appears as equally difficult as the question on the end of archaeology and the beginning of design. The difficulty of making a clear distinction between an observation and interpretation is underlined by the comments made by the informants relating to the difficulties of using documentation, which is made by their colleagues [e.g. D, F, T]. Even if the documentation would be accurate and comprehensive, a secondary user is in an inferior position to the person who created it in the first place, even the person were a colleague i.e. an archaeologist. The documentation may be satisfactory, but never equal to the original record.

The difficulty of creating a comprehensive documentation indicates a further characteristic of the archaeological evidence. The empirical study provide indications that the archaeological material possesses an intrinsic value, which is unsubstitutable by any representations. Reading about an object gives some information about it. Seeing it in a drawing, or preferably in a photograph, unfolds more information [A-Z]. Spectating a three-dimensional model of an artefact reveals even more, but does still fail to communicate its physical full presence: the weight, texture and size, and the experience of actually being with the object [N, V]. The intrinsic value differs from the antiquarian notion of "timeless" value (cf. [217]) and seems to relate more to the notion of the *agency of objects* developed by Gosden [329]. In an extra-archaeological discourse, the objects possess value as cultural artefacts, or following Hjørland, as cultural institutions where the societal flux becomes distilled (cf. [375]). Besides having this kind of a meaning in the society of their origin, the archaeological objects may be argued to have a similar function for the archaeologists working with them. The things and groups of things, may be argued to be distilling and *creating* the societal flux of archaeology, the archaeologists and the archaeological knowledge. The past studied by an archaeologist is the past of the preserved artefacts and sites even if the archaeologist would phrase her questions in a manner, which would be directed to attaining an understanding of past society beyond and contiguous to the known pieces of evidence.

The tendency that objects are warranting the strategies of interpretation compares with the notion of *information artefacts* discussed by Alexandersson and Limberg [13]. The standpoint differs from the Bucklandian notion of perceiving information as a thing [130]. The artefacts are not the information. They function rather as signposts and focal points of an information process, which orient the information work rather towards the procedure than the content. In the Alexandersson and Limberg study, the procedure was dependent on the various types of the artefacts used (books, computer printouts etc.) during the process of information seeking. A book was perceived as a source of a text, which was expected to be learned by heart. The use of a computer tended to reduce the research problem to a single search term [13].

Considerable portion of the intrinsic value of physical archaeological evidence is obviously related to the heterogeneity and general scarcity of the relevant evi-

dence. The paradox of archaeology is in the overflow of evidence and in the simultaneous scarcity of explicitly informative artefacts. Excavations of historical sites tend to produce masses of pottery sherds. Pottery is important evidence, but it is capable to unfold the mysteries of only certain aspects of the human life. The inherent problem with most of the finds relates to the gaps in their contextual information. A pottery sherd, which is dumped in a refuse, indicates that it had been brought there by someone or something, and presumably used nearby. The questions such as by whom, when, why and for what purpose, typically remain unanswered. The difficulty of establishing a complete picture entails that interpretations are often based on analogies, comparisons and indicative evidence. Similarly, the quantitative data has to be used directly to make basic qualitative interpretations without a possibility to ask the subjects or a new group of informants to elaborate on the motivations.

In conclusion, the central aspects of the nature and functioning of the archaeological interpretation consist of the following three notions, which form the basis for discussing the premises of organising and managing the archaeological knowledge and information:

1. First, the process of *constructing* new archaeological interpretations and knowledge, is firmly embedded in the observation and documentation of the archaeological evidence. An interpretation is not a mere translation, but a construction.

2. The second notion refers to the intrinsic prominence of the archaeological evidence not only as evidence, but as a central vehicle of the interpretative work. The interest of the archaeological reasoning is to attain new interpretations, which augment the understanding of past human activities. This interest is, however, emphathetically channelled through the archaeological evidence. Archaeological reasoning is not merely about the resulting understanding. It is more about the process of reaching the understanding.

3. The third characteristic of the archaeological interpretation relates to its contextuality within temporal, methodological, cultural and social boundaries. The archaeological interpretations are difficult to communicate even within the community of archaeologists, because they are contextual not only to the archaeological evidence, which carries an intrinsic value, but also to the act of observation and documentation.

8.2 Knowledge organisation (KO) in archaeology

The current section explicates the purposes, forms and functioning of the archaeological knowledge organisation. The purpose of the discussion is to lay out the forms of how knowledge is organised and what are the premises of knowledge organisation within the context of archaeology. The organisation of knowledge is a central topic of pragmatic relevance in archaeology. In the scholarly sense, the typological description and organisation of artefacts is no more considered to be the purpose of the archaeological research. In spite of the shift of the intellectual focus, the role of organising archaeological material has by no means diminished in the practical work process [616, 100-108].

Archaeology is a thoroughly descriptive and classificatory discipline. Archaeological fieldwork and documentation, and a large part of the academic research is

based on classifications, labelling and organisation of data ([A-Z] especially B, I, T). They are a central premiss of all information work in archaeology. Trigger argues that archaeological classification is grounded on empirical observations, and thus, it may be assumed to be relatively objective by its nature. In contrast, Shanks [679, 118] (ref. also Díaz-Kommonen [231, 215]) emphasises the discursive nature of the classifications and periodisations. The both viewpoints bear a considerable meaning in the light of the findings of the present study. Like information, the classifications are typically used as if they were 'things' (i.e. objective) even though they are in practise, a matter of agreement [I, B]. All classifications are necessarily situated, but within these special classificatory contexts, a basic degree of consistence might be assumed to exist.

As noted earlier in section 8.1.1, the existence of several possible and principally feasible epistemological standpoints causes evident complications to the efforts of managing archaeological information. As Jones observes, the existence of multiple approaches is beneficial for the research [421]. The gamut of viewpoints contributes to the diversity and evolution of the knowledge in the field. Basically, the eclecticism does not have to be a definite impediment from the information management perspective either, but as Gardin remarks, it necessitates the explication and definition of an adequate system of representations, which is capable of covering the needs and requirements of the different users [300, 8].

Gardin has proposed a *logicist* approach with the purpose to "express in the form of chains of explicitly defined operations the reasonings that underlie the constructions of archaeology" [300, 15-16]. At the basic level, the *archaeological constructs* (i.e. information objects with the purpose of explicating "the history and ways of life of ancient men" [300, 13]), are relatively uniform in the structural sense [300, 17]. Gardin divides the constructs to two broad categories: *compilations* and *explanations*. It is axiomatic that the both kinds of constructs may reside in a same publication [300, 22-23]. The compilation may be described as a systematic collage of interrelated information [300, 26]. The explanation is an ordered set of propositions, which forms a reconstitution of the past on the basis of material evidence, possibly combined with other complementary information [300, 27]. The compilations are based on the archaeological material, while the explanations may be derived both from the compilations and directly from the material evidence [300, 28-29]. In terms of their use as information sources, the investigation reports, databases and catalogues are primarily compilations although they always incorporate an element of explanation. A research article built around an explicit research question and a claim, on the other hand, is an illustrative example of an explanation (ref. Section 7.1).

The compilations (e.g. comprehensive dissertations functioning as reference works, databases, catalogues and general references, ref. Section 7.1) are important mediators in the life-cycle of archaeological information (ref. Section 7.1). They are referential constructs to the corpora of archaeological material. A compilation is a compromise between the selection criteria established by the compiler (i.e. the producer of the compilation), and the subsequent users of the compilation. The compromise is both an organisatory and a technical one. The process presupposes a willingness to invest in the necessary information infrastructure and secondly, a technical standard for describing the material in a feasible way both from the compiler and the user points of view [300, 38].

The issue of description and representation is, as Gardin observes, a question of choice between communicating in *natural language* (cf. roughly, the language of

public dissemination and popular media), in discipline specific *scholarly language* (cf. the language of scholarly presentations) or in an *information language* (cf. 'language' of the information infrastructures), which is purposely developed to the aims of documentation, storage and communication. The imprecision and fluidity of the natural languages pose severe difficulties to their formal processing. For Gardin, the solution to the challenge of representation is to use a mediating information language to empower communication between different scholarly communities by referring to diverging scholarly languages. The intellectual process would thus function as a triangular convergence between the archaeological material, compilations (expressed in an information language) and explanations, which emerge and are expressed in a scientific or scholarly language [300, 54].[2]

Gardin categorises the explanations to typological and interpretative constructs. The groups are further broken down to the free, guided and imposed constructions within the category of the typological constructs, and to the primitive, normative and dynamic interpretations in the category of interpretative explanations. The typologies, which are a traditional instrument used in the archaeological reasoning, are explanations (or knowledge), which is based on the notion of formality. Therefore, the typologies are suited relatively well to the formal processing and organisation. The interpretative constructs, on the other hand, are more fluid and basically unfitted for a strict formalisation. Instead of a strictly formal explication, the interpretations may be structured with the help of *semi-formal schematisations*. The concept is used to denote models, which are emerged in a natural language discourse. A schematisation may function as an informal, yet structured and analytical, representation of an explanation [300, 125].

The formal perusal of the intellectual propositions assumes that the compilations are theoretically neutral constructs, which bear a relatively direct correspondence to the observed material. In this respect, a compilation and its intellectual usability is not based on the evaluation of the construct *per se,* beyond the scope of the relevance and accuracy (against fakes) of the accomplishment. The explanations, their validity and status in the intellectual process are, on the other hand, based on the validation of their predictive and deductive power, and the congruence of the construct, with the explained phenomenon [300, 134].

The purpose of the logicist analysis of Gardin is to provide a *schematisation* of the intellectual process in archaeology. Explicitly, it is not to provide a *formalisation* as the author himself remarks [300, 125]. In fact, on a fundamental level of perusal, the interpretative process is mostly barren of formality [300, 123]. The logicist analysis has, however, enabled Gardin to make some normative observations on the future prospects of the archaeological publication. Even if the proposals are explicated as pertaining to the publication of archaeological information, they do reflect mostly how the logicist viewpoint suggests to revise the explicit mediation and organisation of information, i.e. the knowledge organisation in the archaeological domain. The normative principles are:

1. Categorisation of information according to the notions of compilation and explanation would benefit the management of the qualitative aspects of the intellectual process. Gardin proposes a quadripartite classification of information to 1) popular publications of already known materials and ideas, 2) strict compilations of new material, 3) new interpretations (explanations) based on the existing materials, and 4) new interpretations based on new materials.

[2] Djindjian has developed a proposal of a formal language for archaeological reasoning in a series of publications from the 1980's onwards [233][234].

Materials / Ideas	known	new
known	Popularisation of knowledge	Explanations in strict sense
new	Compilations in strict sense	Publications combining new material with new views on the past

Table 8.1: Categorisation of publications according to compilations and explanations (see [300, 156])

2. Scientific writings should include lengthy paragraphs argumenting for their raison d'être.

3. Citings and references, upon which the arguments are based, should be revealed rather than distilled while the argument proceeds. The references should be more thorough in order to act, not merely as indications of the source, but as indications of how and why the source has been useful.

4. The basis of propositions i.e. the archaeological material, its composition, distribution, organisation and relations to the other materials, should be presented explicitly to make the foundations of the arguments as clear as possible.

5. The mutual relations of the entities should be presented in an explicit e.g. tabular form, to empower the making of comparisons.

6. A validation of an explanation should be used as an integral part of the interpretation (i.e. of the final phase of an explanation). The validation is an additional argument capable of supporting the sensibility of the conclusive interpretations. It should be used to ground and broaden the empirical basis of the study.

The principles are based on an assumption that the publications are only seldom read or used throughout. They are mostly browsed, consulted and skimmed rather than properly 'read'. The actuality of the notion was pressing already in 1980 [300, 163-164] and later this kind of consultation has only increased [303][304]. The totality of the available publications serves rather as a fuzzy kind of knowledge organisation system, than as a flowing narrative of resources. In that respect, it might be argued that a collection of publications should be organised in a manner, which allows the consultation of individual propositions, explanations and parts of the compilation. The validity and functionality of the Gardin's propositions is discussed in the following section in the light of the findings of the present study.

8.3 The role of knowledge organisation in the archaeological information process

The scrutiny of the schematisation of archaeological constructs provides a framework for continuing the exploration of the role of knowledge organisation in the archaeological information process in the context of the present empirical study. The logicist proposal provides a structured basis for scrutinising the observations

and findings on the premises and the functioning of the archaeological information process (ref. Section 7.5). The proposal underlines several significant issues in the archaeological information process from the knowledge organisation point of view, although as demonstrated in the following discussion, logicist approach is not entirely unproblematic.

A) The first issue concerns the general matter of structuring human activities. In his studies Gardin has recognised the problematic nature of formalism. The notion of schematisation refuses the rigid formality as a theoretical starting point, but does not manage to escape the related practical problems. In practise, 1) compilations and explanations are difficult to distinguish within the existing information sources. They co-exist in the practical reality as opposed to the theoretical reality discussed by Gardin [300, 22-23]. It is also difficult is to see, 2) how the conceptualisations and descriptions of the archaeological objects and subjects might be clearly expressed in terms of the compilations and explanations (cf. Chapter 7). A same piece of knowledge may be considered to be a compilation by its author, and an explanation by its user, or *vice versa* (cf. theses in Section 7.1.4). Basically any compilation contains an element of explanation. A complete catalogue of the finds deposited in the collections of one museum, is a compilation, but at the same time it is an explanation on a particular period of the past provided 'by' the museum collection. The collection becomes an actor in the process of archaeological information work. The labels 'compilation' and 'explanation' may be used, but it is important to be explicit about their provider, and the motivations and the context of the provision.

Like the classification, the novelty of the contents of publications, is similarly bound to be a relative notion. The principal issue, which relates to the four categories of publications proposed by Gardin is, however, **B) the abundance and the scope of the material** in several categories. Most of the archaeological publications are reports, which tend to reside between the "compilations in the strict sense" and publications, which present new material and new ideas. Scholarly publications belong typically to the category of "publications presenting new material and new ideas" (ref. Section 8.2). As noted earlier, the scholarly publications tend to be scarce in comparison to the amount of the compiled material (ref. Section 7.1). The principal problem seems to relate, however, to the scope of the publications. The generally available compilations are systematically more confined than the emerging questions posed to them. Each phase of the work tends to include a laborious phase of assembling data from a multitude of sources to form a new compilation. The creation of a broader compilation, and developing a practical method of reaching an adequate corpus of information within a limited timeframe, is a matter of personal experience rather than a characteristic of how the archaeological information is organised.

An important observation regarding the principles 2-5 proposed by Gardin, is their relevance in scholarly information processes and yet their practical nonexistence in the individual cases. The basic principle of supporting propositions (explanations) by the references and the explication of the reasoning chain, is widely assumed as the basis of scholarly communication. The discussions with the informants indicated that in practise, **C) the scholarly apparatus is only seldom used to actually check the references.** The propositions are typically 1) judged to be reliable if no contradictory evidence is known personally. Furthermore, the 2) judgement is reinforced by a personal estimation of the proposition itself, and by the manner in which the proposition and its supporting references are construed (es-

pecially in [B, F, G]). In this respect the explication of the reasoning process becomes an essential infrastructural characteristic of the publication (i.e. of a knowledge organisation system), not of the information itself. Therefore, it seems that it would be preferable if the reasoning chain would not reside within the information resource itself baked in the paragraphs or in the extra length of the publication. It would seem appropriate to suggest that a preferable method would be to embed the authority information to a parallel modality of presentation. It would be easily discernible, but simultaneously undisturbing to the principal flow of information. The important factor is, however, to ensure and enforce the presence of the tracing mechanisms, but not to force them to the foreground.

D) The constituent notion on the classification of archaeological information in general and the categorisation to the compilations and explanations in particular, is their embeddedness in the authority structures of the community of archaeologists. The classification of a piece of information as a compilation or an explanation, is dependent on the novelty of the information, and consequently, on the mechanisms of determining what is new and what is already known. The classification of knowledge claims is an explicit act of constructing the claims anew on the basis of the indications provided by a known archaeological record, by setting up an internally coherent authoritative structure of relations. The act of constructing the claims and the emergence of the subsequent infrastructure is an event, which spans over the multiple contexts of production, use, abandoning, discovery and study of the record. The need for the structures is not apparent in the areas of expertise of an individual user or a producer of information. It is more explicit on the borderlines of the well-known subjects and on the areas of knowledge, which have been internalised only superficially. The existence of explicit authority structures and the subsequent references to them, become important especially on these areas of vague knowledge.

The point of confluence for the classification of the archaeological entities (e.g. artefacts such as spears or pottery jars) and the entities of archaeological knowledge (e.g. a catalogue of finds, a typology or an interpretation presented in a narrative form) is that the knowledge is essentially constructed on the basis of classifications (or organisation) and the existence of authority relationships between the individual entities. "Pottery jar" and "compilation", "explanation", "known" or "new" are attributes belonging to the very same infrastructure of archaeological information. The plausibility or accuracy of all the propositions is determined by a reference to an authority within the archaeological actor-driven context of activity.

The notion of referring to an infrastructure as a source of authority compares with the proposition of Frohmann of perceiving a scientific journal as an *objectifying resource* [294]. Frohmann argues that instead of being a vehicle for communication, an article is a discursive resource, which is used to stabilise and standardise the discursive conceptualisations, reconceptualisations and deconceptualisations. Similarly, the classificatory organisation and labelling of some archaeological entities, both data and knowledge claims, is an act of objectifying. The infrastructure of classificatory remarks, is a stabilising resource in a similar sense than an article is for Frohmann. Knowledge claim becomes knowledge only after it is organised using a classificatory scheme and it is compiled to be a part of the existing knowledge.

8.4 Mapping knowledge organisation to the archaeological information process

Understanding the role of the information infrastructures as an objectifying and stabilising structural basis in the context of an archaeological information process forms a basis for looking further to the archaeological information work. The infrastructural dynamics form a basis for explicating the interface between the information behaviours involved in the process, and their implications on the knowledge organisation. The earlier analysis of information behaviours in section 7.3 revealed four distinct behavioural groups: the extensive participants, intensive participants, extensive customers and intensive customers (ref. Section 7.3.1). The mutual dependency of the knowledge organisation and the practises of information work suggests that each of the behaviours may be expected to enjoin a distinct approach to the organisation of knowledge. The approaches may be expected to be reminiscent of each other.

The current infrastructures and practises of archaeological documentation and organisation of knowledge are penetrated by a tendency to inform rather than to communicate. The organisatory schemes and publications are constructed to exist, but not to afford, any distinct kind of information process or behaviour, besides the manual browsing of the repository. An ecologically informed and a more work oriented approach to the management of the knowledge infrastructures would readily suggest considering the actual information interactions as the primary premiss of the construction of the infrastructures. The relevance of a knowledge organisation system is not in its existence, but in its usefulness and appropriateness from the perspective of a particular type of information work, and of the information interactions and information behaviours of the involved actors.

An ecologically valid knowledge organisation system needs to address the relevant behavioural dimensions of the information process (Section 7.3.1). It is argued that the behavioural dimensions may be mapped on an infrastructural level to form a landscape of the basic dimensions of a congruent knowledge organisation system. The knowledge organisation may be directed accordingly to support a particular information behaviour, or all of the identified behaviours within the scrutinised domain. The premiss of the proposition is that the individual dimensions of the information behaviour need to be supported by a congruent function or capability, which is built in the knowledge organisation system.

Following this proposition, the four opposite infrastructural dimensions of an archaeological knowledge organisation system are 1) extensity and 2) intensity, 3) participation and 4) consumerism. According to the ecological nature of the knowledge organisation and information work, the dimensions are further situated on an ecologically evolving continuum of time, contexts and situations (ref. Fig. 8.1).

The convergence between a knowledge organisation system and the entire system of information work is not, however, merely a question of mapping the information behaviours to the information infrastructure. The fluency of the interplay between the infrastructural and human systems is dependent on the functioning of the ecological, processual and systemic joints of the knowledge organisation system and the system of information work. The *systemic* proximity of the knowledge organisation system and the system of information work is a question of supporting the critical success factors of the information work (ref. Section 7.6) and their mapping to the knowledge organisation system. The *processual* proximity is dependent on the support of the coherence and authority (ref. Sections 7.5 and 8.4) of the

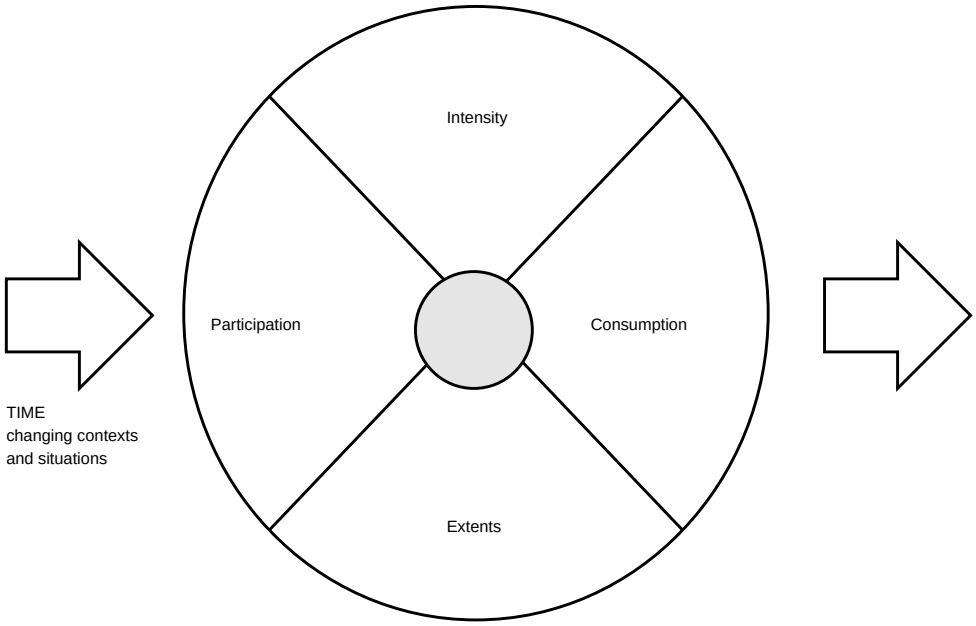


Figure 8.1: Landscape of knowledge organisation based on the notion information behavioural groups and the argument that the behaviour of knowledge organisation needs to match the human information behaviour

information process, which is characterised by situatedness, politics and authority and trust. Finally, the fluency is about supporting the *ecological* requirements of affording some appropriate information interactions and subsequently warranting the infrastructures in course of the life-cycle of information (Fig. 8.2).

The behavioural categories of being a customer or a participant translate accordingly to the direction and functional needs in the interactions. A customer needs navigability and findability [536] within an infrastructure. Depending on the work role, a customer may also participate through making considerable contributions to the information residing in the existing nodes of the organisatory infrastructure. A participant does, on the other hand, not only navigate and accumulate to the fabric of the infrastructure, but contribute by altering and changing its structure and architecture (ref. Fig. 3.1). An overview of the points of convergence between a knowledge organisation system and the information work is summarised in figure 3.1.

8.5 Knowledge organisation and the practises of archaeological information work

The preceding sections have provided a theoretical outline of knowledge (Section 8.1), the premises of knowledge organisation in the domain of archaeology (Section 8.2), and a model, which explicates the convergence between the central factors of the archaeological information work and the systems of knowledge organisation (Section 8.4). The purpose of the present section is to discuss the implications of the earlier discussion on the implementation of knowledge organisation systems in

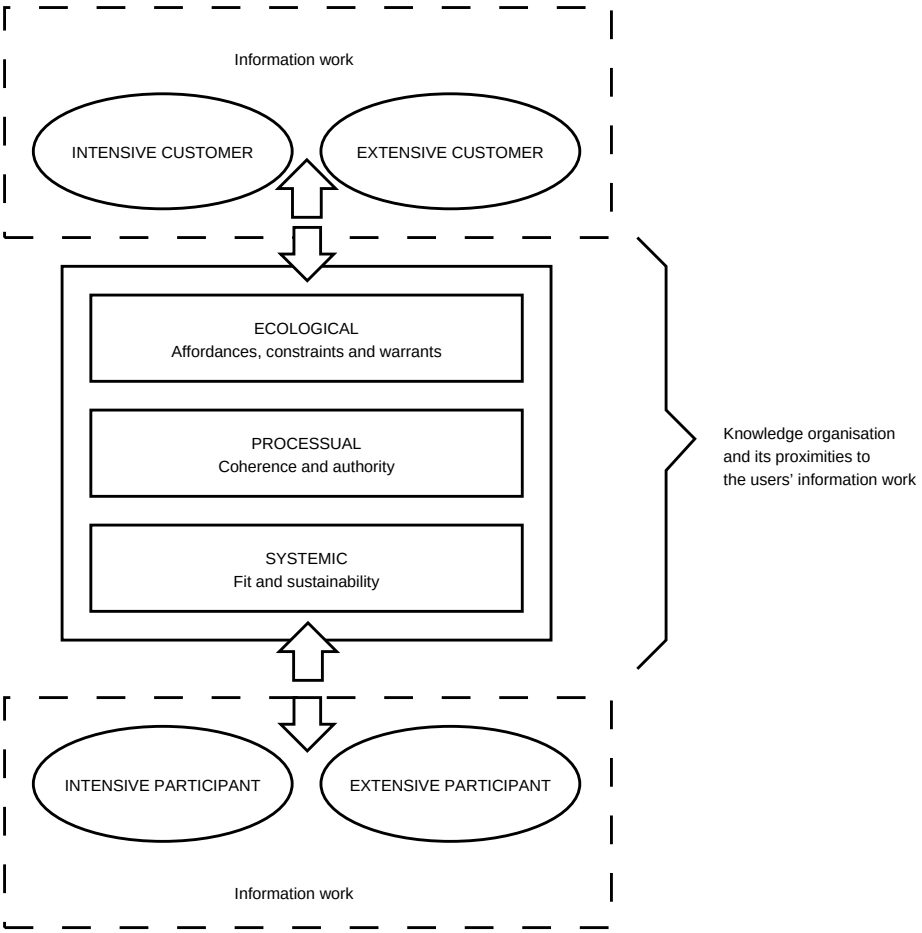


Figure 8.2: Convergence of human information work and the knowledge organisation

practise in computer environments in order to lay ground for the final discussion on the convergence of the archaeological information work and the virtual realities.

8.5.1 Computers and knowledge organisation in archaeological work

In the UK, the computers have been used actively in archaeology since the early 1980's [621]. The birth of the archaeological computing may be traced back to the quantitative analyses launched in the spirit of the emerging processualism in the 1960's [494, 9]. From the early 1980's onwards, the availability of microcomputers brought computing systems closer to the users, because for the first time the archaeological institutions were able to purchase their own equipment. The use of computers was mostly confined to the management of data, analysis, basic word processing and graphics [621, 162]. Some attempts were made in the educational use of the computer simulations [621, 168-169].

The fast pace of technical development during the 1990's has brought the archaeological computing and computerised knowledge organisation to face a completely new set of opportunities and challenges [494, 10-12]. The computerisation has penetrated the entire work process in archaeology and cultural heritage work from documentation to the dissemination [570][805]. Computers are perceived as a necessary part of the archaeological practise (ref. Section 8.6.1) [38]. The progress of computerisation has also had a deep impact in the archaeological work [507], even if the computers are still used rather superficially.

The developments in France and Italy resemble the situation in the UK [339][792] [296]. Attitudes have tended to range from great enthusiasm to a deep pessimism and almost Luddism [390][208]. Even though the informants of the present study expressed a strong opinion against the technological determinism, the warnings of excessive determinism may still be of consequence to the daily practise in archaeological work. Contrary to the elaborated research designs, the routine everyday work becomes easily driven by the available instruments instead of the archaeological considerations [208]. In Finland and Sweden, the use of computers became routine considerably later, first in the late 1980's and in the beginning of the 1990's (e.g. see [427]). Computers has become prevalent in the field work first during the late 1990's [E, H, I, M, P, S, W].

At the present, the computers have penetrated to all basic fields of archaeological work from excavations and surveys to the analysis, communication and management of cultural heritage information. Archaeological computing applications are being developed internationally both in specialised laboratories (e.g. CVR-Lab at UCLA, CNR-ITABC in Rome, VAST-Lab/University of Florence at Prato, Italy, SHAPE Lab at Brown University etc.) and in archaeological institutions as a sideline activity. The Finnish National Board of Antiquities has established a special department for the management of information [541]. In Sweden, the National Heritage Board implements comparable archaeological computing activities with a slightly different organisatory structure [542]. At the moment, there are no specialised research institutes for archaeological computing or cultural heritage computing in Finland or in Sweden. The occasional archaeological computing related projects have been completed so far, as institutional cooperation [798][795].

Computerised information management in archaeology and cultural heritage sector is facing a series of challenges, which range from technical implementation problems to the management of broad horizontal issues such as ethics and cultural differences [506]. The perceived benefits of the computerisation comprise reduc-

tion of costs, rapid access to the data especially in case of the drawings and photographs (e.g. no time consuming processing and post-processing of the films and drawings), environmental control (rapid retouching and reacquisition of unqualified documents), creativity, standardisation of information and improved means of empowering the organisation of data and information [497]. The interest of the present study is focussed on the matters, which may be argued to affect most the realisation of a working knowledge organisation infrastructure, which pays a special attention to the convergence of the information work.

8.5.2 Data structures and knowledge organisation

The data structure related challenges of the practises of archaeological knowledge organisation may be classified to two major categories, the 1) structure and 2) dynamics related issues. The first category relates to the technical issue of how a data structure is capable of representing the complexity of archaeological information (the critical success factor of *fit* in Section 7.6). The second category is related to the question of how the data structures support its dynamics *(sustainability* in Section 7.6). The present section discusses several proposed attempts to tackle these two basic issues with a objective of pointing out and underlining the current data structure related central problems, which concern the organisation of archaeological knowledge.

The early attempts to use computer supported knowledge organisation were significantly limited by the lacking capabilities of the contemporary database systems. Flatfile databases and even the significantly more powerful relational model are not perfectly satisfactory approaches for organising heterogeneous or variable length information, which is available in a constellation of different forms and formats [384]. Even though the technical means to manage the variform data have improved during the last couple of decades, the problem of coming up with appropriate data structures for the representation of the archaeological data, information and knowledge is still topical. The essence of the issue is in the complexity of the relation between the archaeological record and the past, on the relationship between the pieces of documented data and the original record, and on the interplay between the document and its user.

Finding an appropriate data structure requires conformation of the data, data structures and the instruments used in the processing and management of the data. As a textual and pictorial representation, the archaeological report does not correspond with the digital forms of presentation [409]. Orlandi has underlined the constituency of coming up with a "language" of computerised procedures i.e. confronting the instruments and their characteristics to the theory of archaeology [568]. Given the principal strengths of the computers and digital data processing, it is feasible to process the information and data in an according manner as long as it does not interfere with the human patterns of information processing, and the purposes, meanings and values of the associated work and information work (ref. also [805]), and as long as it empowers the involved actors to express their needs and preferences regarding information in a communicable manner [97]. The first problem of the computerised data processing relates to the use of absolute estimations instead of subjective interpretations, which are prevalent in the real-life contexts (ref. [296]). In an attempt to implement a support mechanism for a more advanced degree of subjectivity, Niccolucci et al. have demonstrated the possibilities of using fuzzy logic to represent confidence and reliabilities [547][367][368][208]. Besides

the subjectivity, similarly pressing problems relate to the representation of the complete dimensionality of the archaeological space (ref. [57]), the persisting issue of the huge amount and fast accumulation of data, and the linking and organising of all related information in meaningful entities.

In spite of its evident shortcomings in the archaeological contexts, most of the current data management systems used in archaeology, are based on the relational data model [180] (e.g. [237][395][574]). The basic reason for the prevalent use of the model is that it is the regular data model used in most of the standard data management packages (ref. [83]). The relational model is technically very efficient, even though it is rather unsuited for the processing of heterogeneous and non-standard data. A further deficiency of the relational model is that the eventual attempts to implement complex relations and to model sophisticated conceptual frameworks lead to substantially complex relational structures, which become extremely difficult to manage. The relational model has also been criticised of being inflexible, because altering the basic conceptual structure of an existing relational structure is problematic if possible at all (e.g. [546]). Madsen has demonstrated a method of building a structural scheme for a relational database, which unifies the relational structures, but allows an implementation of varying descriptive schemes on top of the basic framework. As Madsen notes, the proposition represents an improvement compared to the eventual use of individual database systems and structures in each investigation. He acknowledges, however, that the proposed model is not the ultimate solution, which might simultaneously guarantee the flexibility and consistency of all archaeological documentation and representation [501].

The apparent problems of the relational model have lead to proposals of using more tractable data models. Hyperlinking represents an exemplary alternative approach, which has been suggested as a substitute to the relational model (e.g. [8]). Especially the promises of the XML-based technologies and the Semantic Web movement have evoked a special interest. The XML promises to deliver a flexible, man and machine readable, easily annotatable all purpose data storage [546][665][545][58][82] (ref. also [145][639]). However, the problems with the theoretical performance, slow pace of standardisation and practical availability of suitable low-cost and easy to use XML-applications have slowed down the implementation of systems.

The poor fit of formal data structures in archaeology, is a result of the nature of the archaeological knowledge[3], which is based mostly on hermeneutical interpretations instead of ontological representations of truth (Section 8.1, cf. [89]). Veltman summarises the essential cultural heritage related problems of the present ontological approaches advocated by the Semantic Web movement to the issues relating to the 1) management of different world-views, 2) evolution of the definitions and meanings, 3) distinction between the words and concepts, 4) handling of the new classes of relations and 5) dynamism of the models of knowledge organisation [799]. Lock has proposed a conceptual model (ref. Fig. 8.3), which integrates the computers into the hermeneutic spiral of the archaeological reasoning and shows the mediation between the past and the archaeological interpretations of the past. According to the model, the past is sampled as an archaeological record. The record is documented by an archaeologist in a *data model*. Simultaneously with the documentation, the archaeologist produces a *theoretical model* of the past state of affairs. In a computerised milieu, these two models are combined to a *digital model*, which is further used as a basis for the eventual inferences about the past and the present

[3] The notion is not archaeology specific, but applies to a broad spectrum of human information.

(ref. Fig. 8.3). The essential issue of the appropriate structures and representations of data is how to properly describe the different models and to enable and subsequently document the associated interpretations.

The Semantic Web advocates address the notion of multiplicity of knowledge claims by introducing an approach of formally maintaining, mapping and managing multiple coinciding ontologies (i.e. 'multiple overlapping truths') [502]. From the ontology point of view, the overlap, evolution and different versions are a problem, which requires specific management [555]. From the hermeneutically aligned knowledge and information point of view, on the other hand, the approach of seeing the overlap as a problem, is a problem itself, because according to the viewpoint, knowledge is perceived to be overlapping *per se*. There is a clear difference between expressing a claim as an interpretation or as a parallel truth. A claim is plausible according to some premises, while an ontological truth (even if parallel to another truth) is definitely true within the confines of a particular ontology.

Another apparent problem with the ontology oriented viewpoint is the management of the practical issue of constructing ontologies. It is a slow and costly process, which is unlikely to reach and outdo the pace of the emergence of new information ([422] cf. e.g. [624], ref. also [413][753]). The hermeneutical critique of the ontologies and knowledge organisation does not necessarily imply that they would be irrelevant for the purposes of managing information. It is, however, important to underline their practical limits and to keep in mind that they are far from being a 'silver bullet' (cf. [266, vi]).

The issue of the rigidity of data models has also been addressed by the proposal of *dialectical data processing* of Shinoto [688]. According to this approach, the data repositories are reinterpreted at intervals according to the newly established paradigms by using a set of modification rules. The proposal bears considerable meaning as a solution to the management of formal rework. The approach is not, however, capable of addressing the issue of managing changes, which can not be modelled in the formal language provided by the processing system.

A further approach to counter the rigidity of the ontologies and taxonomies is based on the so called *folksonomies*, which rely on the collective tagging of resources and the clustering of the assigned tags. Kansa suggests a folksonomy based approach for archaeological documentation [430]. The social tagging is not, however, without its intrinsic problems. Tags are potentially useful, but they do not *per se* negate the need of formal taxonomies. From the management point of view, the most acute concern with the approach is that the folksonomies are equally difficult to control or manage as the knowledge and information are. Social tagging may empower usability and make information more findable [326][537], but it does not contribute specifically to making it more manageable.

Several researchers have emphasised the importance of distinguishing 'facts' and 'fiction' (e.g. [651][655]) and proposed a variety of approaches to manage the uncertainties and imprecisions of the archaeological knowledge. Accary et al. have developed an idea of explicating time in archaeology by using a temporal model known as the Allen's relations [17][3][4]. Niccolucci and Hermon have suggested using fuzzy logic to represent uncertainty [367][368] and Carver has referred to the possible usability of artistic expression in the archaeological plans and cross-sections [149]. Appleton, Sebrechts and Zuk [674][30] have suggested using graphical ques, such as the effect of blurring uncertain details, to express their uncertain character. Kozan [453] suggests using layered images, which compares with the technique of using layered three-dimensional presentations evaluated during the

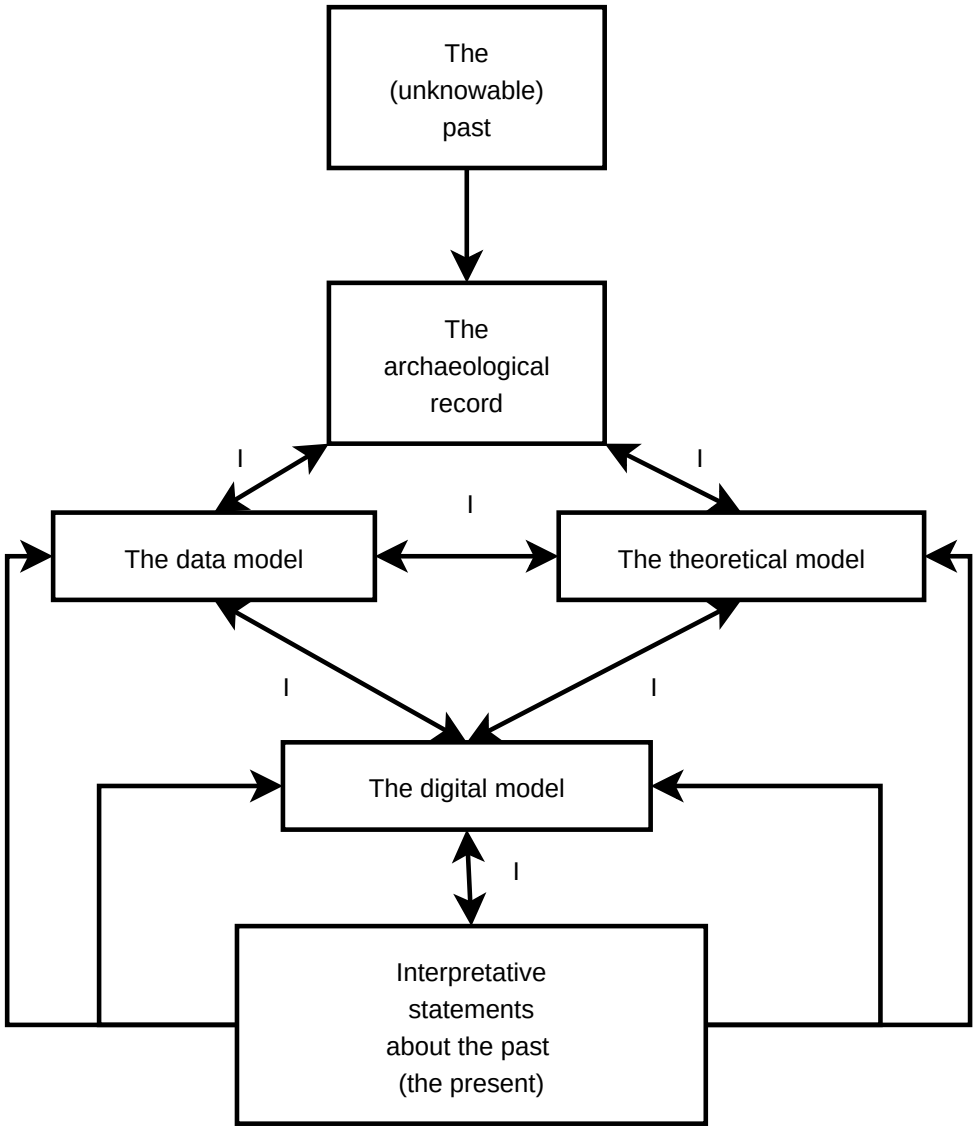


Figure 8.3: The integration of computers into the hermeneutic spiral showing the area of mediation between the past and the present. I=Interpretation (from [494, 7 Fig.1.1])

Naantali project in Finland (on the project ref. [798]).

Bénel and his colleagues have been conducting intensive research on the management of archaeological information. Their viewpoint builds on combining networked structured graphs with a theoretical background building, among others, on the notions derived from the Memex of Bush [134]. The focus of the studies has been on developing a system called Porphyry to manage, annotate, describe and organise archaeological document collections in a manner, which would benefit the archaeological reasoning [86][88][89][85][87]. Bénel et al. propose hermeneutic digital libraries [89] and suggest for the purpose an approach building on an acyclic graph based indexing and annotation model, which is accompanied with a filtering algorithm. The model is designed to empower browsing, and the exploratory and contextual nature of the human information seeking behaviour [86]. In spite of its apparent virtues, also this approach relies on the problematic idea of a universal classification of the documents and concepts. In archaeology, the concepts are evolving and the data is accumulating without any foreseeable possibilities for controlled iterative revisions of the descriptions, which makes the classification basically unfeasible to manage. The idea of collaborative annotations supported by a collaboratively used information system suggested by the authors, shows some theoretical promise, but faces some extreme difficulties on the level of practical accomplishment. The case example from the field of classical archaeology used by Bénel et al., may be argued to be in this sense, a positive exception, because the terminology and the research traditions of this particular field of archaeology might be described to be exceptionally well established. However, even then we face the problem of making a clear distinction between the artefacts labelled, for instance, as belonging to two different, but contextually overlapping categories, such as "early Christianity" and "late Antiquity".

Bénel et al. also acknowledge the issue of contextuality and situatedness of the process of archaeological interpretation. A suggestion to address the issue is based on the management of documents by implementing a functionality of providing the context through the use of "traces", i.e. contextual references to *notes*, *sources* and *fragments* organised into a hierarchy of generalisation and specification [89].

The inherent problem of the systems, which are based on the notion of organising and annotating documents, is the observation, which was underlined earlier in the present study that in several instances, the archaeological information work is not based on the use of documents, but on the archaeological material and on the social organisation of the community of archaeologists. Considering the patterns of information use in the archaeological work (Section 7.4), the findings of the present study indicate the constituency of 1) maintaining a persistent framework of data structures, 2) of the need for a special emphasis on the tracing and description of the relationships between different entities, 3) the focus on the purposes, meanings and values associated with the information, and of 4) allowing the information itself to be contextually determined.

8.5.3 Life-cycle management

Besides the problems of representation, the organisation of archaeological knowledge is challenged by the issue of managing the temporal and dimensional span of information and the constructs in which the information is stored. The discussion of the information interactions pointed out a large number of obstacles, which were directly related to the management of the quantities, relevance and appropriateness

of the available information (Section 7.4). Archaeological information management is partly a question of managing the large quantities of archaeological data [296]. The management is dependent on the availability of workable data structures and representational frameworks, but more than that its success relates to the persistence of the information and its representations.

The technical life-cycle of the storages is typically shorter than the one of the information (e.g.[43]). The knowledge and its organisation are changing all the time. The basic observations are, however, principally cumulative and thus retain their value and importance over an indefinite period. The cultural, societal and technical contexts, in which the information originates, do change over time. Therefore, the question of conserving archaeological knowledge structures and its organisatory constructs presupposes an active process of change with the context of the knowledge organisation system. Otherwise the information would not retain its intelligibility and usability. As Lock observes, the contextual revolutions like the recent changes in the information and communication technology, place archaeology and archaeological informatics in front of a series of more profound changes than merely a process of adapting of a set of new technologies in use [494, 253-268].

The bulk of the computerised archaeological information systems (like the information technology in organisational contexts in general, ref. [213, 37-38]) are based on the notion of transferring the existing manual practises to a computer without a proper consideration of the information itself (also remarked by Kay and Cross [438]). Archival practises and regulations steer the form and contents of the deliverables in many cases, but even the materials, which are provided by the archaeologists for an archaeological use, tend to follow the existing practises and forms of layout and organisation. The standard organisation typically springs from the physical organisation of materials (i.e. finds, reports, tools, interpretations) (e.g. [231, 177]). The persistence of the practises is a natural consequence of the force of habits, the availability and known (at least relative) functionality of the traditional work flows and the reluctance of the organisations to take the risk, which is an invariable part of the changes. Exemplary proposals of digital and virtual life-cycles and workflows exist in the recent literature (e.g. [395][482]), but in spite of the suggestions, most of the archaeological work does seem to follow the manual work flows according to the informants interviewed for the present study.

The successful management of the persistence and adaptability of the knowledge infrastructures presupposes a twofold approach. First, 1) the process assumes an effective strategy for the management of the adoption of technology and new tools for obtaining and organising knowledge [800][497][166]. The adoption is, however, only a temporary measure of empowering the transition. Ultimately, the developing organisation needs to conform with the purposes, meanings and values of the work. The transition presupposes that both the work and the technology adapts. It is important that the process and the procedures of the work do not remain unchallenged when their strategic nominators change.

The 2) second precondition is a strategy for the management of the adoption of an appropriate knowledge organisation scheme. Workable standards are essential in the process, even though their essentiality is paradoxical considering the constituent problems, which relate to the formalism and classifications (ref. Section 8.5.2). Considering the adaptability, the role of the standards would appear to need to be shifted from the primary purpose of providing a structure and conditions to how to do the work, to the explication of how the work has been done, what has been preserved and what has been purged (ref. [249]). A descriptive reference

model provides a framework of domain and work roles for the information work. Besides explaining the frames of the work, it can also provide the means to understand the premises of the organisation of knowledge. In this respect a high-level model does not have to be universal or all-inclusive (cf. [548]). The only requirement is that the model would be capable of explicating a small, but a meaningful part of the reality for a short, but a sufficient period of time.

The number of the proposals of packaging the entire archaeological information process in a single system has increased during the last decennium. In spite of the thrive for comprehensiveness, the suggestions do still tend to follow one of the three orientations explicated by Voorrips [805]. Depending on the commissioner of the project, the efforts tend to be either COPs (collections oriented projects), POPs (planning-oriented projects) or ROPs (research-oriented projects) [805] (ref. [I, O]). Integrated information systems and procedures have been developed in large multinational collaborative projects [342][194][441][443] and on a national level in various infrastructure programmes (e-Science in the UK, the Silchester VRE [604][240][239]), by national archaeological heritage administration bodies [627][505], larger university departments and laboratories [664][792][665] and by private enterprises [36][483]. In spite of the occasional claimed universality of the information management systems, their application may prove to be difficult out of their original contexts of design [605]. The practical and administrative distinctions of archaeological work in different countries causes serious problems even if the system would basically support a flexible customisation of the data, data entry and processing [N, O]. Another typical issue is related to the differences of scale in the systems and in the contexts of use. A large excavation needs a large and flexible system. In a small project, it might prove to be highly inefficient [J, O].

A further significant issue, which is related to the creation and provision of the digital resources, is their applicability to the wider framework of archaeological, or in broader terms, humanities and social science research and their related non-academic work. The supposed reference models need to be extended to comply not only with the archaeological requirements, but to enable significantly wider mappings across the traditional disciplinary borders. The recent national and international efforts in the digitisation of cultural heritage and the management of the cultural heritage assets have helped taking some important steps towards providing the humanities and social sciences with more efficient and effective digital resources compared with their predecessors (e.g. [801]). The work on the general issues, which concern the cultural heritage in information society of the digital era, have been addressed from the 1990's onwards within the framework of the projects such as MUISTI [363], KULDI [562], Kamut-2 [790] and eKAM [435] in Finland, and for instance, the ALM (archives, libraries and museums) cooperation in Sweden [575]. Similar initiatives have been launched and are being launched throughout Europe, even though the scale and ambitions of the different projects vary considerably [526]. A fair progress of the efforts requires efficient management of the whole life-cycle of the cultural heritage assets and a close consideration of several contextual matters such as ethics, institutional relations, technology and cultural issues [506]. A kernel of such initiatives should be to take into account the special positions and needs related to the different instances of work and work roles ([801] and [506], ref. also [92]).

8.5.4 Fit and sustainability

On an elementary level, the issues, which relate to the development of appropriate representational structures, and the management of their persistence throughout the life-cycle of the knowledge organisation system, revert to the issues of fit and sustainability, which were identified as the critical success factors of archaeological information work (in Section 7.6). Finding an appropriate (digital) structural framework to represent the archaeological data is a question of conforming the structures of human information with an appropriate set of computer based structures. Managing the persistence and controlled change of knowledge structures is, by other words, managing the sustainability of the underlying infrastructures.

Richards and Ryan identified in 1985 [622, 16][494, 4] four data collection related factors, which empower the computerisation of archaeological data:

1. Duplication should be avoided in the selection of attributes.
2. Attributes need to be separated of the attribute states.
3. The deliberate human selection needs to be identified on an appropriate level of precision. Only reasonable attributes should be documented.
4. The frame of reference of study affects the required information.

In spite of their age, the factors have retained their basic validity. They do, however, reveal the immanence of the problems, which relate both to the fit and the sustainability. The first two observations are rather unproblematic as they effectively address the issues of retaining the consistency of the information structures and of the avoidance of unnecessary labour. Both of the two aspects are important in the sense of making the structures sustainable. Duplication leads to conflicting information and unnecessary work, which hinder the effectiveness of the future work with the infrastructure.

The latter two factors are more contextual notions. Their implications can be decided only on the basis of the present situation, and the decided implementations need to be augmented to accommodate imaginable future changes. In practise, a feasible approach is to decide the level of precision and the impending information needs according to the present standards and future expectations on the basis of the available resources. Similarly it is important to ensure that the contents are flexible to update and restructure. Besides the information work, the appropriate precision is also relative to the precision of the available instruments. Computers allow artificially high levels of precision and do unwittingly support a sense of spurious accuracy even when the initial data is far from being precise [431]. Therefore the fit of the actual precision and the documented precision needs to be considered and documented meticulously before embarking on the voyage of actually interpreting the data.

Orlandi [567] summarises well the constituent premises of archaeological informatics while discussing the ideas of Guimier-Sorbets [341] on the role of multimedia in the publication of archaeological materials:

1. Like all scientific disciplines, archaeology is concerned on the treatment of information: The relation of archaeology and informatics and multimedia may thus be divided into three phases: elaboration of the documentation, interpretation, and diffusion of the results.

2. The third phase, diffusion, has to be based on the notion of publishing cumulative information.

3. The second notion begets a need to make effective typologies and to standardise archives and the archival processes.

4. Empowering the communication of ideas and information between researchers is constituent to the archaeological work.

Orlandi discusses further the notion of archaeology and informatics from the viewpoint of cognitive archaeology (introduced by Renfrew [616, 369-372]), and makes an important observation of their relation to the archaeological cognition. The constituent issue of the computing and the use of multiple forms of media in archaeology, is not directly related to the technology, but rather to the general tribulation of formalism in the humanities [567] (cf. [566]). Lock points out that the use of computers do not only change the ways things are done, but they change the way people think about their doings and their motivations to do something [494, xiii]. Informatics does not concern merely technological issues, but has a deep impact on the methodology of archaeology through the introduction and emergence of new forms of codifications (cf. [565]).

In spite of the constituency of the information and communication technology and the process of computerisation, the present study would be inclined to argue that the computers themselves do not beget independently any constraints or affordances associated to the systems of knowledge organisation. In spite of the significance, which computers have in provoking changes, the findings of the present study underline their instrumental role. The ecology of information work, which has been described and explicated on the basis of the empirical findings, is not profoundly 'computer minded'. Its complexity and contextuality, and its deep embeddedness in human processes underline a need to focus on accordingly complex, contextual and embedded infrastructures. The computers do change the ways how people are thinking, but mostly and most profoundly only after the computers have been introduced into the service. Instead of the computers, it would be essential to concentrate on how the work is actually being done and why the work practises and procedures have evolved to what they are. The fundamental complication of organising and managing archaeological information processes is in archaeology and the archaeological information itself, and in the complexity of their meanings in the social and cultural perspectives. The references to the information work, information technology and information behaviour do act only as utensils, which may facilitate the work, but also the understanding, changing and adapting to meet the current contexts. The instances where the computers are a primary issue, become actual at the moment of translating the complex and fluid infrastructures into a digital form. The findings suggest that the most significant issues are how to represent the nodes and the structure of the knowledge claims, and how to cope with their dynamics in a digital reality.

8.6 Archaeology and virtual realities

The present section discusses the interface between archaeologists, the practises of archaeology and virtual realities. Adopting a broad understanding, the virtual reality systems and the concept of 'virtual reality' are perceived to embrace everything, which is, or has been, called a "virtual reality" in the archaeological contexts. The

perusal is focussed on the relationship between the archaeologists, archaeology and virtual realities, and on explicating the interface between the archaeological information work, and the notion of virtual realities understood in the sense discussed earlier in section 3.2.2.

8.6.1 The everyday life of virtual realities in archaeology

The empirical investigation of the present study incorporated a tentative assessment of how the informants would orient themselves in a virtual reality environment. The assessment was completed by interviewing the informants by referring to their previous experiences and personal expectations about their motivations, interest and a tentative 'need' of virtual reality based information systems. On the other hand, the interviewees were asked to estimate the supposed ease or difficulty of using a virtual reality system in their practical work. The interview was complemented by an imagination exercise (Appendix B, Section "Imagination exercise"), which was used to generate creative thinking on the basis of their professional experience as archaeologists, their earlier experiences on virtual reality like implementations and on the basis of the stimulus provided by the interview. The principal aim was to get the informants to consider their own work in terms of virtual realities and to make them to propose improvements on the present state of their information work. Earlier, the imaginary methods have been used successfully in design to stimulate new thinking and to arouse comprehensive understanding of the topical issues [485, 209-259].

The informants were generally speaking rather well informed of the recent developments in the archaeological computing. They were able to name several different projects, which involved or had involved multidimensional graphics and some type of technology, which had been denoted as the"virtual reality". The great variety in the familiarity with the concepts "three-dimensional computer graphics", "virtual reality" and "virtual environment" between the informants was not surprising, because of the widely ambiguous use of the terminology in the archaeological contexts. The word "reality" was rejected by several informants, because it was considered to be referring fallaciously to an actual 'reality' of a computer generated replica. Most of the informants showed higher preference for the concept 'virtual environment', apparently because of the rejection of the term "virtual reality", which was discussed directly before the latter term.

All of the informants were notably optimistic about their willingness and capabilities to learn to use systems, which implement three-dimensional graphics and 'virtual reality' elements. The informants, who had more experience of CAD, 3D-modelling or other computer graphics software, were more pessimistic about their present and future skills (e.g. [A, F]). The opinions conform with the experiences of the adaptation of digital information processing tools, reported in the literature. Bates, Wilde and Siegfried [67] write about humanities scholars working with the DIALOG databases. The responses of the Bates et al. study show similar tendencies with the expressed hopes and anxieties, which were observed during the interviews conducted for the present study. The interviewed scholars were generally positive with the new methods of organising and leveraging information, but they submitted some reservations concerning how they would get used to the system and about the possible unwanted effects, the system might have on their scholarship. Furthermore, the scholars were positive about the possibilities of using online tools for acquiring interdisciplinary information (ref. [67]) in similar fashion to

# respondents	Benefit
7	you can go inside a site
7	composite of thematic layers
6	you can see the contexts
3	remote availability
2	replay of an investigation
1	composite of temporal layers

Table 8.2: Perceived benefits of using virtual reality in archaeology

# respondents	Interaction method
9	Sight
5	Computer metaphor
2	Exploration
2	Speech (discussion)
1	Using a tool

Table 8.3: Preferred interaction methods

the archaeologists who underlined possibility to use a virtual reality system in an interdisciplinary communication (e.g. [L, P]).

The perceived benefits of such systems varied according to the distribution shown in table 8.2. The figures indicate the number of informants who referred to each benefit during the interviews. The table 8.3 summarises the accordingly collected preferred interaction methods.

The idea of asking about the preferred interaction method, was to *look* at the environment from different angles. The *computer-like interaction metaphors* were also popular candidates. *Speech* and *sound* were mentioned by two informants as the preferred mode of interacting with virtual surroundings. The findings cover most of the current trends and conceptions of how the virtual reality interactions works. In spite of the lack of decisiveness of the research method, it seems plausible to suggest that the notions of *going inside*, and *experiencing the spectrum of the contexts and themes* are important in archaeological thinking. According to the findings, it seems also possible to place a tentative emphasis on the visual, contextual and compositional nature of the archaeological work, because the mentioned qualities were incontestably the prevalent themes in the interviews and imagination exercises.

The most of the informants saw spontaneously the principal benefits of the present virtual reality realisations in the public dissemination sector. The virtual realities were seen in the contemporary society as a media of the younger generations, which warrants its use in the communication of archaeology (e.g. [L, P], ref. also [657]). As a scholarly project, the evident lack of matured methods and inexpensive readily available and easy to deploy and use applications for the archaeological research purposes hold the virtual archaeology in the margin.

The public dissemination use of virtual realities is linked to the use of the virtual realities in the management of the sites. The interviewees suggested a possibility to use a virtual reality system for the planning and documentation of research and conservation work [A, C, T] in a manner, which conforms with the proposals of Counsell on the stages of the process of conservation of the historic monuments, in which the virtual realities might be used. Counsell proposes that the application areas of the virtual realities comprise 1) the use of a virtual reality in a preparatory

or briefing role before setting a foot on the actual site. Secondly, 2) the models may be used to immerse users in environments, which do not exist anymore and to augment their present state of conservation with reconstructed information. Finally, Counsell suggests that 3) the complete replicas may be used to visit and inspect the sites in distance [195] (ref. also [336]).

An interesting point is that none of the informants mentioned collaboration or collaborative use of resources as a central benefit of the virtual realities beyond the one-directional contact of showing archaeological research results to the public. Theoretically, a virtual reality might act as a device for telepresence, which is capable of empowering the archaeologists to do remote consultation and investigation. Comparable telepresence applications have been developed for surgeons, for the purpose of being able to consult a paramedic or to operate in distance [514][533]. The omission of the collaborative applications may be explained by the fact that in the archaeological discourse, the virtual realities have been considered primarily as objects instead of (participatory) environments (cf. other areas of application e.g. museums [122]). Another plausible explaining factor is the archaeological tendency to organise collaboration around specific events (e.g. project) and event-like physical objects rather than communication infrastructures. Like most of the frequently used tools and literature in archaeology, the virtual reality is seen from a personal point of view, rather than as a communal resource or a shared information space.

The expressed opinions, which concern the preferred use contexts of the virtual realities correspond largely with the findings of Karaseitanidis et al. [432] in the context of an evaluation of several virtual reality products. Only one tentative deviation is discernible. The interviewees seemed to place a greater emphasis on the potential educational use of the virtual realities. A plausible explanation of the emphasis is that most of the informants had more personal experience on educational virtual reality projects than of design or research oriented efforts ([D, E, G, H, I, J, K, L, M, P, R, S, V, V, W, X, Z] cf. [A, B, C, F, Q, T]). The applicability of the virtual realities in an archaeological simulation and in the review and evaluation of scholarly propositions, has been touched briefly in the literature. A number of researchers have made several different propositions for developing a 'grammar' for expressing the validity of the virtual reality arguments (e.g. [651][291][652][546][797][76]). In spite of the propagation of the awareness and the required technical skills, the 'everyday archaeology' is still notably far away from being capable or prepared to exploit the potential of the virtual reality based methods and techniques.

Because of the observed variety of the archaeological information work and information objects (Chapters 5 and 7), it is clear that only one kind of information and one kind of an approach to the organisation of information hardly meets all the expressed needs and requirements. At the present, it would be constituent to come up with an educated understanding of the prospects of managing effectively the diversity of the archaeological information. Thereafter the priority should be to empower the archaeological information work with an integrated set of befitting (virtual reality based or not) instruments of knowledge organisation and processing.

8.6.2 Virtual realities and the archaeological reasoning

The most trivial reason to consider the virtual realities as a plausible knowledge organisation scheme in the cultural heritage information work, is that all tangible cultural heritage is (at least) three dimensional (ref. [308, 48]). In its simplicity, this

notion is not, however, entirely unproblematic. Technologies and organisatory approaches, which implement dimensionality, are undoubtedly useful in (semi-)direct reproduction of objects and materials. From the information viewpoint, however, the exact reproduction of the objects is not necessarily the principal form of communication. The priority is to empower the representation and communication of *information*.

Virtual realities, like most of the computerised presentations of the cultural heritage assets, have raised conspicuously black and white estimations. Computers, multimedia and virtual realities have been either a promise of a glorious future or a dangerous weapon, which might eventually marginalise the craft and the results of the humanities scholarship [305]. To avoid the latter gloomy, yet somewhat improbable, future prospect, it is important that the subject expertise of archaeology is involved in defining, discussing and creating the applications and establishing their priorities (ref. and c.f. [231, 161]). It is necessary to understand the instrumental nature of the infrastructural information systems regarding the (archaeological) work. The good working relations between the information specialists and the subject professionals are not necessarily enough. There needs to be a common understanding of the goals, priorities and possibilities. Díaz-Kommonen reports of a series of knowledge sharing and exchange attempts during the Raisio Archaeology Archive project. The attempts were not successful in bringing the communities of designers and archaeologists closer together. She concludes that the reason of the failure to do so, was the physical distance, ideological separation, the difficulties of departing from the traditional working habits [231, 234] and "the lack of motivation from not having a clear enough picture of the potential benefits" [231, 165]. The conclusions underline the findings of the present study regarding the salience of a thorough understanding of the archaeological information work.

The guidelines of good conduct in archaeological virtual realities described by Alonso et al. represent a rather typical list of conditions according to which, a qualified archaeological reality should be built [19]. The guidelines emphasise the archaeological basis of the realisation, distinction between the measurements and hypotheses, interactivity and reversibility, ease of use, and an orderly management of temporal and spatial dimensions.The principles are based on the idea of making information available without any special reference to the actual patterns or practises of use apart from the vague reference to the approachability through the notion of ease of use.

The guidelines compare with the findings of the present study on the prevalent patterns of documenting and storing archaeological documents. The discussions with the informants highlighted the constituency of two distinct issues related to the 1) interface of virtual reality presentations and the contemporary methods of archaeological presentation (namely photographs and drawings) and on the other hand on 2) the complex relationship between the presence of actual, interpreted and imagined in the virtual landscapes. The issues are discussed in a more detail in the following two sections below.

8.6.2.1 Drawing or a photograph

The benefits of virtual reality applications and multimediality have been seen typically in two sectors of archaeology. The virtual realities have been proposed to be used in empowering archaeological reasoning and especially in the communication of archaeological knowledge to the public [567] in a sense, which has been referred to as *heritage interpretation* [457]. The recreation of worlds has become almost an

icon of the computer graphics in archaeology. Pettigrew, who is acting as the president and executive director of the Archaeological Legacy Institute best known of the website archaeologychannel.org, stated in October 2005 that "computer generated 3D animation, which now has come of age, can recreate for us worlds that are long past" [588].

Although a three dimensional model may be considered to be a three dimensional drawing [779], the virtual realities do incorporate both photographic and drawing-like capacities. The preferability of one of the two media is a rather twofold question. A drawing is always a highly subjective representation. Its quality and accuracy are always compromised by practical constraints [45]. However, a drawing is often seen as a preferred mode of visual representation in the archaeology, because of the possibility to select, emphasise, edit, and mediate relevant information [7, 6-7, 80][235, 129][45][231, 201]. Eriksdotter makes an interesting reference to Barthes and to the defects of photography stating that a photographic documentation is "uncoded" in comparison to a drawing [255, 120]. A drawing is capable of communicating the purposes, meanings and values attached to the activity (the work) of creating the representation in a more rich sense than a photograph. A drawing is more tightly under the control of the drawer, albeit an archaeological drawing is not, however, a predominantly expressive form of presentation. Banning emphasises this special resonance of the archaeological drawings in contrast to the artistic impressions. An archaeological drawing is a coded representation of the observations made by an archaeologist, not an expression of artistic creativity [51, 291].

In a proposal of carrying the notion of coding further into the archaeological reasoning, Díaz-Kommonen compares drawings to the Latourian *inscriptions* [231, 205]. Inscriptions are visual representations used to persuade other archaeologists to accept an argument. The process of creating an inscription renders the original information invisible and leaves only the purposefully constructed argument available [471, 21, 64-74].

The notion of the inscriptionary qualities of the archaeological documentation does not, however, confine itself to the drawings. The archaeological report, which is compiled after each field work season, may be seen as a grand inscription. The explicit purpose of a report is to collect the field observations, finds and all other 'raw' information into a compilation. In case of an excavation, the report becomes a sole existing piece of evidence, which reproduces the features of the original site. In every case, a report is typically the only account of a particular investigation process. For the investigating archaeologist, the report is also simultaneously a device for presenting a personal interpretation and, subsequently, for maintaining and strengthening the own personal position within the community of archaeologists. A report is thus a device of documentation, but it has also the secondary role as a device of influence and power, which makes it resemble an inscription. Reports may be seen like Díaz-Kommonen sees the drawings, as "interpretative diagrams" rather than as reproductive drawings [231, 207] or reports.

Like a drawing or a report, also a virtual reality may be seen as an inscription. Their composition makes them intrinsically interpretative. The interpretation is accentuated throughout the life-cycle of the virtual realities, which makes it a constituent quality of the life-cycle and the virtual reality itself. In this respect a virtual reality is as much a composition of information as it is a result of its own process of coming-to-being. Multiple authors have observed that the users of virtual reality systems are seldom provided with information on the sources used to make the

"reconstructions" [317][231, 122][255, 174-175] (cf. [281][19]), or rather constructs, referring to the terminology, which has been used earlier in the present study. It is important to make a virtual reality to contain meta-information, to link it to the underlying 'archive' of information [284], and to be truly 'transparent', even if the interpretative nature of the virtual realities makes it difficult to articulate the transparency.

In spite of the apparent importance of the drawings, it was interesting to see that the most of the informants of the present study indicated that they preferred photographs of the original sites and artefacts to the drawings [A, B, I, L, M, N, O, P, T, V, V, W, X]. In spite of the remark of Dorrell that a photograph is only rarely capable of revealing such details, which had not been noticed in the stratum during the excavation [235, 129], it seems that the multiplicity of the possible interpretations and research interests is consequential to that in the first place, the interviewees tended to prefer a photograph to a drawing. Drawings were perceived to have more explanatory power, but they were likewise seen to be less value-free than the photographs [A, B, R, W] (ref. also [231, 210]). The subjectivity of a drawing is apparent. However, as Shanks underlines, not even a photograph is entirely value-free. The act of selecting a target and taking a photograph is equally situated in a context and thus represents a subjective view of the site [680]. Another plausible reason, which explains the preference for photographs, is the phenomenon of *immersion* (Section 3.2.2.4), which also explains the significance of the personal contact with the sites and artefacts (Section 7.1.1).

The scrutiny of photographs and drawings seems to warrant two significant arguments. First, neither of the forms of representation seems to be exclusionary to each other. The second argument is that it seems that a virtual reality might be argued to provide the means to combine the notions of 'drawing' and 'photographing' by 'adding' a further *dimension* to the representation. To be precise, the addition is not a mere addition, but a rather substantial change in the whole procedure of communication (e.g. adding text to a multimedia, ref. [851]). Avern argues for the preferability of three dimensional drawings over the combination of two dimensional plans and profiles and photographs and states that the documentation is faster, the models are more accurate, they contain more information and are more flexibly usable after the excavation [45]. Unlike in the proposition of Avern, it is suggested that the addition of a dimension is not merely a question of precision and amount of information. The engagement, interactivity and dimensionality augments the representation by another framework of interpretation. Lehtonen et al. report of a trial of emphasising and discerning various features and stratigraphic layers visible in the photographs by using digital overlays [483]. A similar approach has been employed earlier by drawing on Polaroid snapshots [235, 121]. A virtual reality provides similarly means to augment the original photograph not only by the precise drawn and written remarks, but also by the dimension of perceiving and structuring the original information. In comparison to the photographic approaches, the use of virtual reality technologies holds a potential to empower the documentation work with an increased dimensionality and flexibility at a reduced cost. The virtual realities provide means of recreating the entire investigation and documentation process, and any of the subsequent developments, within an integrated environment.

The scrutiny of the special capacities of the photographs and drawings provided two important insights into the eventual convergence of the archaeological information work and virtual reality based knowledge infrastructures. Both the

photographs and the drawings incorporate a distinct method of emphasising and simplifying information, which are of consequence to the archaeological communication. First, the interviewees indicated clearly that if the authority of the simplifier or emphasiser is not considered to be adequate, they would turn to a set of sources with less built-in interpretations even if the material (i.e. photographs) would be more cluttered and in some aspects, even less precise. The observation underlines the significance of a personal interpretation, which draws directly from the act of imagination. The second remark concerns the frame of reference. The increased number of dimensions empowers the virtual realities to incorporate more emphasises and simplifications within a single frame of reference. A virtual reality is not a single photograph or drawing, but an assemblage of a theoretically indefinite number of dimensions.

8.6.2.2 Imagination and interpretation

Díaz-Kommonen suggests that a constituent benefit provided by the virtual reality representations, is their capability to provide a more free and imaginative way to look at the archaeological materials [231, 122-123]. The idea of exploring, imagining and experimenting in a virtual reality was repeated in several interviewee accounts of the present study [A, E, L, T]. It is discernible that the virtual realities may be used as a freeform sketching tool to augment what is already known about the archaeological materials and the past. Compared to pure statistical and mathematical analyses, the virtual realities permit a seamless combination of quantification and a qualitative examination and evaluation of the results (e.g. in [845]).

The imaginative and experimental use of the virtual realities is, however, conditional on 1) the archaeological information process and 2) the purposes, meanings and values of the archaeological work. From the information process point of view, the notion of 'freedom' or experimenting must be coupled with the necessity of enforcing restrictions (ref. Section 7.5). A virtual reality is useful as a practical scholarly tool only when it is capable of maintaining an appropriate framework for the information and its organisation.

From the archaeological information work point of view, the central issue of imaginative exploring is the notion of its limits. As Krasniewicz suggests, the power of the virtual realities lies in their capability of restoring some of the archaeological context so that the archaeologists can see where and how the data were found (ref. the use of moving image in Section 7.1.8). Researchers can be provided with a possibility to get immersed into the origins of the data with the help of a computer instead of having to resort to the traditional set of textual descriptions, photographs, maps and drawings [456] (ref. Section 7.1.8). Uotila and his research team has used virtual reality techniques and multi-dimensional modelling in field archaeological stratigraphy [788][784][482]. Vote et al. propose a 'virtual reality workbench', a virtual reality based visualisation application, to function as a substitute for the two or quasi-multidimensional geographic information systems in the visualisation of find deposits, plans and profiles [806]. In both cases, the virtual reality provides a framework for the immersion. Besides the experience of engagement, immersion and dimensionality, it is important that the system provides means for a specifically 'archaeological engagement' instead of an extra-archaeological, for instance, an artistic one [53]. To counter the confusion, Viti has suggested a clearer distinction in the terminology between the *virtual reconstructions* (i.e. constructs of non-existing entities) and *virtual reproductions* (i.e. virtual copies of existing entities) [803].

The overall relevance of discussing the imagination and interpretation aspects of the archaeological virtual realities is that there is no interpretation without a degree of imagination. The informants indicated that in routine tasks they would be inclined to rely on authoritative accounts and statements [e.g. C, W]. In complex tasks, and in situations when there is no authoritative information present, the formation of an interpretation was told to assume a complex effort of studying primary accounts and establishing an 'image' (broadly following the idea of Boulding [108, 5-6]) of the matter of concern. The once established image evolves, becomes challenged by new information and interpretations. It is reestablished repeatedly in a new form. Therefore, in the sense of the archaeological information work, it seems that an important contribution of the virtual realities lies in their capability of encapsulating the dynamics of the archaeological reasoning and interpretation with the imagination.

Bringing together the discussion of the interfaces of the virtual realities and the archaeological reasoning in the two previous sections (Section 8.5.2 and the present section), the principal observations may be concluded in an elaborated list of conditions (cf. the list in Section 8.6.2) for a qualified archaeological virtual reality:

1. Virtual reality is a scholarly transparent reconstitution of an archaeological record. In a technical sense, a virtual reality is not a faithful reproduction, but it may serve as an 'augmented drawing' of the original.

2. The sources and the process of reasoning behind all 'constructed' information, needs to be clearly indicated. It is important to communicate whether a piece of information is acquired by measuring or by hypothetical deductions, but it is equally significant to explicate the methods and bases of the measurements and hypotheses.

3. A virtual reality needs to be interactive, complementable and reversible and it needs retains the information about the modifications and their rationale.

4. The interface and the entire infrastructure of the virtual realities need to be intuitive (including 'sensible' and, to a degree, 'easy') to use with a domain specific expertise for the domain specific objectives.

5. A virtual reality needs to provide an infrastructural framework to the information work by managing the constituent factors of engagement, interaction and dimensionality.

8.7 Information viewpoint to the archaeological virtual realities

The diverse conceptual and technical possibilities offered by virtual reality based knowledge organisation approaches show special potential in several fields of the archaeological information work. The purpose of the present section is to bring together the considerations of the general qualities of the virtual realities (Section 3.2.2), the dynamics of the archaeological knowledge organisation (Section 8.1) and the discussion on the contemporary experiences of the archaeological uses of the virtual realities (Section 8.6).

Together with the theoretical considerations, the analysis of the empirical findings of this study suggest that a virtual reality based knowledge organisation system is likeliest to contribute to the success of information work, which embodies the following elements:

1. *Complexity*: The notion of complexity relates both to the intricacy and fluidity of the organisatory and structural network, but also to the complexity caused by the amount of information. Archaeological knowledge landscape is not placid, in spite of the theoretical infinity of the interpretative frame of the archaeological information. The organisation of the archaeological knowledge evolves according to recognisably ambiguous, but still discernible patterns of the contextual continuum from the past to the present. The patterns of the knowledge landscape may be expected to follow the patterns of producing, using and abandoning the pieces of material culture, the ways of how the remains change and deteriorate, and finally, the workings of the archaeological investigation and interpretation. The virtual reality and information visualisation research has for a long time acknowledged the power of the human visual perception in recognising patterns [517, 358][592] and distractors preattentively [809][357]. The applicability of visual perception of regularity is emphasised in the data prospecting i.e. finding interesting areas for analysis in massive data sets [522][517, 358]. The typical, non virtual reality kind, computational data processing methods fit well to small and moderate size data sets, but they do not generally scale well into truly massive ones [517, 357]. Archaeological data is not massive in the sense astronomic data is, but the present problems in cultural heritage information management indicate clearly that it is too large and too complicated to be controlled without assistance.

2. *Benefits of close situatedness vs. distance*: Situatedness relates to the emphasis of the spatial and contextual location awareness of the individual instances of the information work and information. Archaeological material, and consequently the professional and research related contexts of archaeology, are pronouncedly situated in the physical spaces of the past, present and the period between the present and the discussed moment of the past. The situatedness spans over the cultures and societies of the past and over those of the interpretation. A virtual reality provides means to express contexts and spatial situations, locations, distance and movement in a potentially illustrative manner. The capability of a three-dimensional spatial representation is fundamental to the graphic virtual realities, but the concept of virtual realities might be taken to suggest a more complete set of dimensionalities of the cognitive, cultural and social interaction beyond the scope of the visual space. In the essence, a virtual reality based information infrastructure might serve as a platform for a more comprehensive kind of tele-archaeology than the one of a telecommunicated *spatial* engagement with archaeological subjects proposed by Barceló et al. [53].

3. *Illinear organisation*: The illinearity of organisation relates to the number of gaps and inconsistencies in the organisation of the materials, interpretations and consequentially, of the information and the premises of the information work. Archaeologists need to use indicative material, make analogous inferences and to construct evaluations based on merely indicative structures of

knowledge. The virtual realities *afford* illinearity through the notion of situatedness within a framework of infinite dimensionalities and modalities.

4. *Mediated physicality*: The investigation of the archaeological information work suggests the special relevance of the physicality of information in archaeology. Archaeology is not merely *about* objects, but it is *of* objects. The possibility of a visual and haptic reproduction and mediation offers a potential for supporting the tractable physical engagement also in distance.

5. *Multimodality*: The modalities of the archaeological information work concern principally the physical modes of interaction. Archaeology is about materials and thus about working with the physical world. Beyond the scope of the immediately material world, archaeology does, however, grasp the modes of experiencing the physical in its cultural, social and cognitive contexts. The multiplicity of the modalities of interaction offered by a virtual reality may be extended to provide means to represent the modalities, which relate to the archaeological work.

6. *Multidimensionality*: The notion of multidimensionality is related to the complexity of the archaeological constructs (ref. [57]). Besides the three physical dimensions and the dimension-like quality of time, the dimensions of archaeology grasp a multiplicity of interpretational and perceptual dimensions of reference, which relate to each piece of archaeological evidence and material. Through the affordance of multidimensionality, the notion of the virtual realities may be used to represent and work with the multiplicity of dimensions related to the contexts of the archaeological evidence and archaeological knowledge.

The complexity of the virtual reality structures and infrastructures is the source of their potency in the diversity of archaeological tasks, but also their debility in working with relatively simple, directly computable, linear and one-dimensional information. In this respect, the suggestion of Jablonka et al. that the virtual realities combined with databases would make "a logical next step of archaeological information management", is highly intriguing [406]. The practical example they present, is a rather straightforward realisation of using a virtual reality system as an interface for querying a database, but the suggestion itself is more far-reaching. The suggestion of combining the two notions of databases and virtual realities may be seen as a more constituent notion of integrating two different ways of working with the archaeological information: the present (databases) and a new one (the virtual realities) without substituting one with another. This particular issue of integrating the virtual reality based approaches and the complex information work to less complex information infrastructures and procedures of information work, is fundamental from the information management point of view. In the essence, it is a question of providing an adequate fit between the levels of complexity, and finally making the process to be sustainable to the eventual changes.

8.7.1 Work roles and processes as warrants of the virtual reality based knowledge organisation

One objective of the present study has been to explicate systematically the premises of using a virtual reality system as an instrument of knowledge organisation in archaeological work. The findings suggested six information related characteristics

(ref. Introduction and Section 8.7), of archaeological work, which are echoed in the capacities of the virtual reality based knowledge organisation. A relevant further question is to explicate the precise instances of how the characteristics distribute in the system of archaeological work, become warranted, and afford and constrain the actual information interactions.

Because the warrants function as the criteria for constructing, maintaining and using a system of knowledge organisation, they are based on the existing contextual organisation and its distinguishable components such as the culture or literature. The analysis of the information work (in Chapter 7) suggested that the warrants are related closely to the organisation of information and work, which is manifested in the work roles, work horizons and information horizons of the individual informants. The work roles represent structural dissections of the work processes within a domain and their analytical groupings. The information horizons are, on the other hand, expressions of the organisation of information within the context of a work role specific information work.

The work processes, work roles and work horizons, which are potentially warranted by the virtual realities, articulate through the expressed and tacit purposes, meanings and values of the work. The purposes, meanings and values express the complex and multimodal qualities of being interested in something, seeking, finding and creating information and knowledge, and learning (vs. retrieving). The focus of the emerging benefits *afforded* by the virtual realities: the engagement, interactivity and dimensionality, centres around the activities of accessing, using, creating and authoring. On the other hand, the virtual realities *constrain* linear and uniform information processes, rapid retrieval and recall (vs. indepth recognition) and 'passive', non-participatory, activity.

An information horizon and a work horizon, which is fitted for the virtual realities, is complex and consists of multiple and multimodal information sources. There is seldom a single main information 'database', or if such a source exists, its role remains of a little consequence in the entire scope of the information process. A single source may be a starting point, but it often fails to satisfy every need. The information seeking is based on browsing due to the impossibility and infeasibility of directed searches. On the other hand, the information needs to be rather specific to warrant the complexity of the virtual reality based knowledge organisation. If a very general kind of information or tool may prove to be satisfactory, a relatively random and unspecified access should prove adequate results. It is important, however, not to be confused by the complexity of the horizon caused by inadequacy of instruments (i.e. of the information sources and management tools). It seems that a virtual reality supports only actual, work related complexity of the information horizon. An *ad hoc* complexity of information is an issue of bad organisation, not an intrinsic problem of the work or information.

The central characteristics of an information work, which is likely to be supported well by the virtual reality systems may be summarised as following:

1. The information horizon comprises clusters of information resources, which are determined by the objectives of the related work. The clusters consist of heterogeneous sources of specific information, which is used in a parallel and networked manner. The work does not rely on one primary source, or merely on organised and already existing 'databases' or general presentations. The virtual reality system, which is developed to support the work, may simplify and emphasise various aspects of the information, but these aspects need to be selected by its user. The selection has to be based on the criteria of sup-

porting the specific, non-simplified objectives of the present instance of the work.

2. The work role and the related work process enjoins a level of complexity and illinearity, which is impossible to make linear and uniform while retaining the fundamental purposes, meanings and values of the work. The work presumes engagement and interaction also outside the scope of virtual realities.

Considering the findings of the present study on the information horizons (Section 7.1), the specifics of the work roles, interactions, and processes (Table 7.8 and Figs. 7.3, 7.4, 7.5, 7.7, 7.6, 7.8 and 7.9), the explicated characteristics seem to articulate most clearly in the following three work roles:

1. **Academic research**: The work process in the academic research work role is complex and nonlinear, and its directness is typically more exploratory than definite. The academic research work assumes the use of a variety of sources, which are available in multiple forms and modalities. The relevant information horizon is dispersed and consists of relative few sources, which are readily available, and are formatted in a manner, which is in line with the requirements of the research activity. The heterogeneous nature of the research work effectively inhibits developing a uniform set of tools for the researchers. The relevant information is typically very specific and the specificity of earlier information is also in the focus of phrasing the subsequent information needs.

2. **(Research oriented) fieldwork:** Research oriented fieldwork differs only slightly from the academic research in the respect of the layout of the relevant information and work horizon. On the level of the purposes, meanings, and values, which relate to the academic research and research oriented archaeological fieldwork, the differentiation between the two work roles becomes rather artificial, because they are connected to each other in an organic manner. However, the contexts and situations of the work are considerably different between a research investigation and the subsequent phase of academic research, which makes the distinction relevant from the practical information systems development point of view.

3. **Cultural heritage administration (cultural heritage policy subsystem):** The cultural heritage management work role grasps different heterogeneous activities, which are related to the general objective of managing and preserving relevant archaeological heritage assets. Much of the non-linearity of the cultural heritage administration may be explained by the unavailability of integrated information repositories. Compared to the administrative duties, the policy subsystem of the cultural heritage management work role (Fig. 6.13) is more exploratory by its nature. The relevant information sources and processes are also more dispersed than in the routine administrative duties.

Outside the scope of the present study, which focusses on the archaeology professionals, it seems to be feasible to expect that the customers of the academic teachers and public disseminators might benefit of the virtual reality based knowledge organisation, especially if the teaching and dissemination is directed to support constructive learning and acquiring of information. This customership is not work role oriented within the scope of the archaeological information work, but rather spans

across the entire spectrum of work and covers the instances where the initial level of experience on a given matter is low and unestablished. In practise, the observation suggests that a virtual reality based knowledge organisation might be expected to show potential in providing an adequate basis for an individual to attain a relevant understanding for assuming a work role.

It is important, however, to consider virtual reality approach only if the complete learning and acquiring process is designed and planned accordingly to function through the aspects of engagement, interaction and dimensionality. The borderline between visualisations and virtual realities is vague, but meaningful. Sebrechts [674] proposed that a virtual reality provides means to extend a visualisation to become a component of experiential learning. In the light of the present study, it would seem to be more relevant to operate a virtual reality rather on the level of communicating experiences than on the level of visualising notions or things. The aspects of dimensionality, engagement and interaction are components of an experience rather than characteristics of an image.

The findings of the present study showed coincidental work processes and information horizons also in other work roles than in the academic research, (research) field archaeology and cultural heritage (policy) administration (Chapter 6). Considering the profiles of the cultural heritage administrator (Fig. 7.8), infrastructural developer (Fig. 7.9) and antiquarian (Fig. 7.4) work roles, a virtual reality based knowledge organisation system might prove to be beneficial in some tasks pertaining to these work roles . The work of the informants whose work descriptions incorporated these work roles, incorporated problem solving, which resembles noticeably the work of academic researchers. The information horizons were broad in these work roles, the horizons comprised heterogeneous sources and evidenced especially of a broad variety of information use strategies. Similarly, their phrasing of questions resembled conspicuously academic research.

The close inspection of the CATWOE analyses reveals in these instances, however, that the principal purposes of the work process do not indicate of a need for complex information work procedures, if adequate information would be readily available. For instance, the administration subsystem of the cultural heritage administration work role does not attempt to produce new archaeological understanding of the past phenomena, but to provide formal statements based on the existing interpretations. The activity does not presuppose a complex process of research-like information work. The lack of adequate resources, however, turns the work to a research assignment. Similarly, at the present, an antiquarian needs to do unnecessarily intensive manual information work, because of a lack of adequate tools and information repositories available for the management of the collections. As emphasised earlier, it is important to note that the nonexistence of an adequate management system is not a plausible reason to incorporate a virtual reality based knowledge organisation system. A workable solution for this kind of an issue is not to attempt to support the complicated information work procedures of the present, but to provide more adequate tools and to change the information work to focus back on its essential purposes, meanings and values.

8.7.2 Ecology of the archaeological virtual realities

The practical motivation for considering virtual realities as a system of knowledge organisation in archaeology, is based on an expectation that the approach might *afford* (and lift *constraints*) (ref. Section 2.6.5) some of the essential procedures of the

information work. Two of the three focal aspects of the virtual realities, *engagement* and *interaction*, suggest directly that the notion is closely with being a *participant*. Therefore, a virtual reality based knowledge organisation system should be built to systematise information and makes it available through participatory behaviour, incorporating the third structural aspect of the virtual realities: the *dimensionality*. The principal affordances of the virtual realities are related to a *participatory* information behaviour instead of a consumptive one (ref. Section 7.3.1).

The participatory information work tends be *labour intensive*, and *systematic* in compliance with the purposes, meanings and values of the work. The work is primarily concerned with *working on directly relevant information objects* instead of meta-information. One of the principal obstacles of this kind of work, is the *lack of resources* to pursue far enough with the interaction. Especially characteristic to the work is that the information interactions combine access and utilisation of information grasping both the exploitation of and contribution to the resources. The participatory interactions grasp an intricate information horizon, which comprises complex networks of heterogeneously interrelated information resources. The information interactions are typically situated in a transient context of the present understanding of the current phase of the work process. Proceeding to the next information source or stage in the work process requires careful consideration of the current context. The contextual dynamics also explain why the authority and importance are seldom prominent categories, which steer the interaction in a virtual reality. Besides the authoritative accounts, also an unauthoritative and trivial information contribute to the understanding and are an inseparable part of the information process. False assumptions and anecdotes may serve as contradictory examples or they may bridge a gap between two authoritative pieces of information.

The constraints of an effective utilisation of the virtual realities to support consumptive behaviour, relates to various factors. The virtual realities afford systematic interactions, but are deficient in communicating information, which has not been emerged in its context in a process of engagement and interaction. Similarly, the virtual realities are inefficient in exhaustive information seeking. The process approaches exhaustivity when the duration of the interaction is long and the engagement is deep. However, the process may become effectively exhaustive only in a contextual sense. The understanding of the knowledge organisation, which is mediated in a virtual reality, becomes deep and thorough, but is not directed towards covering exhaustively all of the individual pieces of information in a similar manner to an exhaustive database search.

The aspects of dimensionality, complexity and nonlinearity of the virtual realities might be taken to indicate the preference of an intensive rather than an extensive behaviour. A constituent question is, however, what is the focus of the intensive behaviour. From the virtual reality point of view, the participation to the virtual reality needs to be intensive, not the interaction with the organised information. Therefore, the virtual realities may be taken to afford both intensive and extensive participatory information behaviours, while they, for the same reason, constrain primarily consumptive information interactions.

8.8 Summary

The present chapter has explicated the nature of the archaeological knowledge and knowledge formation processes, and their subsequent implications to the layout of

the knowledge organisation in archaeology. The discussion underlined the significance of the *contextual interplay* of the interpretations and measurable data. The key issues, which support the archaeological knowledge process reside in 1) an effective realisation of appropriate data structures, in 2) the management of the information life-cycle and in 3) the meeting of the critical success factors (*fit* and *sustainability*, in the case of archaeology) of the overall domain-specific information process.

From the knowledge organisation point of view, the principal strengths of the virtual reality based approach relate to the effective communication and management of the confluence between the complex and nonlinear, diverging and overlapping interpretative dimensions of the archaeological information (i.e. provision of a sustainable fit). A reference to the information work analysis suggest that the notions of dimensionality, complexity and nonlinearity were in an especially predominant position in academic research, research oriented fieldwork and in the cultural heritage policy work roles, which makes them focal from the virtual reality based knowledge organisation point of view.

Part III

Discussion

Chapter 9

Information work and virtual realities

The aim of the present research was to examine the organisation of information work and its expressions in the human work processes. In the first place the study aimed to develop a working approach for acquiring an understanding of the implicit information related issues of the practical work and describe them in an explicit manner. The second important purpose of the study was to discuss how to operationalise the acquired understanding so that it could be employed in the processes of designing, constructing and using information and knowledge organisation systems. The overall research question was **how the use of virtual reality environments could benefit the management of information work by empowering the knowledge formation and communication processes**. The specific addressed questions are (for details, ref. Section 1.2):

1. How the systemic notion of information work functions as a conceptual tool for analysing and discussing work related information activities in a context?
2. What are the critical issues affecting the success, effectiveness and efficiency of information work in the domain of archaeology?
3. Can a virtual reality be used as a framework of knowledge organisation to manage information and information processes in order to empower information work?
4. How would an eventual virtual reality based knowledge organisation map for the different aspects and types of information work?

It is important to note that the present study is a study of premises. The aim of the investigation was to peruse the practises of human information work and the possibilities and premises of managing and facilitating that work with a knowledge organisation system, which is based on the notion of virtual realities. The intention has not been to suggest a preference for a particular existing 'virtual reality' system, nor to build a new one. These tasks have been left for the forthcoming research.

The initial impetus to study archaeological information work may be explained by the author's earlier personal experience in working with archaeology and archaeologists. Another important motivation were the growing intellectual and practical concerns of empowering the management of archaeological heritage and

archaeological information to function effectively and efficiently from the preservation and communication points of view. At the present, the archaeological topics have significant and growing communal, economic, cultural, scholarly and societal implications. From the information science point of view, the archaeologists do represent an interesting domain of information work where the notions of complexity, overlap, time, materiality and interpretations have a significant impact.

The study was conducted by interviewing 25 archaeologists from different organisations in Finland and Sweden. The interviews were laid out as thematic discussions. The interview material was used to construct an analytical classification of the archaeological work based on work roles, CATWOE-analysis, use case modelling and analytical information horizons mapping. The work role based classification was confronted with an explication of the informants' information behaviours, which was deduced from their information interactions and information resource use. The analysis resulted in an analytical description of the ecology of the archaeological information process (Section 7.5) and in the identification of two critical success factors (*fit* and *sustainability*) of the archaeological work (Section 7.6).

The attained understanding of the information work process and its premises was discussed further in conjunction with the notion of using virtual realities as a form of knowledge organisation. The purpose of the discussion was to indicate the potential points of convergence between the *ecology* (ref. Section 2.6.5) of the archaeological information process and the ecology of the virtual reality based knowledge organisation.

9.1 Information work

The current section presents the conclusions of the investigation regarding the archaeological information work by answering and discussing the first two research questions first presented in section 1.2.

9.1.1 Archaeological information work

9.1.1.1 How the systemic notion of information work functions as a conceptual tool for analysing and discussing work related information activities in a context?

The theoretical assumptions of the coexistence of the work and information work and their close convergence was illustrated in the empirical investigation of the present study. Even if an archaeology professional is not explicitly engaged in a traditional 'information work' (i.e. the work of an information specialist), they work constantly with information in order to cope with the issues of their everyday work.

The central findings of the current study, which concern the archaeological information work, are explicated in the analysis of the major work roles, which are related to the archaeological work, and in the subsequent analysis, which focussed to the embeddedness of the roles in the practises of information interactions and information behaviour. Consequently, the analysis proceeded to the explication of several prominent notions, which concern applicable information infrastructures and the organisation of the information work. The knowledge organisation need to support the information work from 1) ecological (how the infrastructure and information work interact), 2) processual (what is the basis of the process of interaction

and support) and 3) systemic (what are the long term issues, which affect the success of the interaction) points of view (ref. 8.4. The focal issues of the archaeological information work, according to the present investigation, were summarised in two critical success factors.

The analysis of the interviews resulted in the grouping of the work duties in seven distinct work roles:

1. *Field archaeology*: The field archaeology work role consists of a range of duties, which relate to the archaeological excavations and surveys.

2. *Antiquarian*: Antiquarian work role relates to the collection and artefact maintenance and customer service work conducted at museums and other cultural heritage institutions.

3. *Public dissemination*: The work role consists of a spectrum of duties related to the dissemination of the archaeological information to the general public, using a variety of 'media' from museum exhibitions to the books and television documentaries.

4. *Academic research*: Academic research work consists of the traditional academic research work conducted at the universities, and secondarily in the museums and other cultural heritage institutions. The work role excludes field work, which is separately covered by the field archaeology work role.

5. *Academic teaching*: The work role grasps the entire range of academic teaching from undergraduate courses to the supervision of the doctoral dissertations.

6. *Cultural heritage administration*: Cultural heritage administration involve the duties of the administrative staff, policy workers and managers of the investigation and maintenance projects in the cultural heritage administration bodies. The duties comprise indirect customer service, informing, definition of guidelines and good practises, policy making and implementation, surveillance and maintenance of the cultural heritage sites.

7. *Infrastructural development*: The work role involves development of working methods and techniques in all fields of archaeological research and praxis.

An important finding of the present study was to point out the contexts of the work roles in the archaeological work. The work roles are a conceptual tool for explicating and identifying different 'locations' where the work, and more precisely, the information work, resides within work processes and on the life-cycle of archaeological information. The work roles are not exclusive. They are combined in the job descriptions of the individual archaeologists. Apart from being an analytical unit of the work practises and information processes, a work role is an important structural factor in the work and the information. Work roles provide a working means to bridge the notions of information work and information behaviour, and consequently the notions of human behaviour and the critical success factors of information work. The present study assumed a work role based approach instead of a task based one (ref. Section 2.5.1) because of the scale and scope of the study. The focus on an entire domain of work and its internal similarities and dissimilarities made the tasks too specific a level of conceptualisation.

Besides the seven work roles, the current study identified four types of information behaviour. In spite of the fact that the grouping is based on the information

Information behaviour	Work roles
Extensive participants	field archaeology, (academic research)
Intensive participants	antiquarian, cultural heritage administration (cultural heritage policy subsystem), (field archaeology, academic research)
Extensive customers	public dissemination, academic teaching, infrastructural development
Intensive customers	Cultural heritage administration (administration subsystem)

Table 9.1: Information behaviours and associated work roles

behaviours of the individual informants, the grouping indicates a clear analytical correlation with their assumed work roles (as illustrated in table 9.1). A constituent adjoining observation was, however, the existence of a hierarchy of dependencies between the different components of the work and information work. While the information sources and work contexts of the informants showed distinguishable individual variation, the information horizons and work horizons converged tightly with the work roles associated with the individual informants (ref. Section 7.2). In conclusion, it seems that the systemic notion of information work is a viable instrument for discussing and analysing information activities in a context. The principal points of convergence for the information work, work and the workers are the information and work horizons, work roles and the individual information behaviours.

9.1.1.2 What are the critical issues, which affect the success, effectiveness and efficiency of information work in the domain of archaeology?

The analysis of the archaeological information process in the framework of the information behaviours and work roles resulted in the identification of two critical success factors, *fit* and *sustainability* (ref. Section 7.6), which are decisive for the successful outcome of the archaeological work.

The notion of fit relates to the mutual coherence of the communities of stakeholders. The most fundamental problem of fit in the archaeological information process is the problematic gap between past human beings and the present community of the archaeologists. It is essentially a scholarly issue of archaeology, but its presence has also a deep impact on the information work. An equally consistent information management issue of fit is the bridging of the gaps between the different work roles and the notions of work within the community of archaeologists. The polarisation of the archaeological work to the professional and scholarly spheres needs special attention. The professional work needs to be professionalised further by developing the processes and by emphasising both the economic and usage oriented criteria. At the same time the scholarly work should be given a proper position and space in the work process in order to allow the intellectual benefits to emerge. At the present, it is clear that the needs and viewpoints of the producers and users of the archaeological information do not meet at a satisfactory level, and the archaeological work risks both at wasting resources and losing unrecoverable knowledge potential by an only partially effective management of the information resources and knowledge.

The sustainability of the archaeological information work concerns the physi-

cal endurance of the monuments and archaeological collections, and the economic sustainability of the maintenance work. Another dimension of the sustainability is the sustainability of the transfer of the intellectual work in archaeology. The paradigms, priorities and manners of expression do change over time. Despite the changes, the communicativeness of the information needs to be maintained and, in effect, made sustainable over time. A focus on the amount and technical accuracy of the minute technical details of the documentation is not enough to attain this objective. A special emphasis is needed on the communication of the purposes, meanings and values of the work, and the contexts and situations of the information.

The analysis of the informants' information work and information source use did also rationalise a series of explicit recommendations, which affect the management and support of the archaeological information work:

1. The prevalent positive attitudes towards the electronic data repositories and information resources should be taken as an impetus to work further on the computerised archaeological information management and the development of the electronic information resources (ref. Section 7.1.6).

2. The present efforts to secure the completion of a comprehensive documentation of each archaeological investigation need to be further emphasised to avoid the loss of information due to an inadequate or unfocussed reporting. Simultaneously, there is a need to consider more closely the relation of the documented details and their relevance to the presumable forthcoming use of the reports (ref. Section 7.1.10).

3. The findings of the present study suggest that the process of emergence of knowledge could be better described as something happening than something being done. Even if a lot of knowledge related activity is intentionally knowledge orientated, the studied material shows clearly that the constituent factor behind the eventual knowledge is not something 'being done', but rather something 'taking place', because of a diversity of things are being done. The archaeological fieldwork provides means to construct an estimation of past human activities in the relative vicinity of a precise geographical location. The actual estimation is not, however, a predetermined construction, but an amalgam of intentions, and of contextual, systemic, infrastructural and environmental determination. The process is controllable, but only to an extent. The fundamental observation made on the archaeological information work, is that the knowledge and information are not constructed by people alone, but the knowledge and information participates the construction activity as actors of equal importance to the human-beings (ref. Section 7.5.1.1).

4. The physicality of information bears a special significance in the archaeological information work. Not only the archaeological materials themselves, but also the secondary sources and presentation of the archaeological information was expressed to benefit of a physical presence and of a concrete possibility to touch and see the objects and sites (ref. Section 7.5.2.3). Therefore, it seems that the development of the archaeological information practises and techniques need to be explicitly sensitive to the physicality and careful in the attempts to substitute it.

5. Considering the patterns of information use in the archaeological work, the findings of the present study indicate the constituency of maintaining a persistent framework of data structures, the need for a special emphasis on the tracing and description of the relationships between different entities present in the information infrastructures, a focus on the purposes, meanings and values associated with the information, and of allowing the information itself to be contextually determined (ref. Section 8.5.2).

Besides the two critical success factors and the list of recommendations, a further key observation of the present analysis of the archaeological work relates to the overall significance of the information work in the context of archaeology. It is apparent that the archaeologists need increasingly thorough education in the information management related topics such as documentation, storage, management and use. It is important to raise the awareness and understanding of the information management and the mastering of the related basic techniques among the archaeology professionals themselves. Besides this elementary work, it is apparent that there is a need for a group of information management specialists with a thorough understanding and experience of the archaeological frame of reference.

9.2 Virtual realities

The current chapter presents the conclusions of the investigation regarding the applicability and use of virtual realities as knowledge organisation system by answering and discussing the two latter research questions presented in Section 1.2).

9.2.1 A bridge between the archaeological information work and virtual reality based knowledge organisation

9.2.1.1 Can a virtual reality be used as a framework of knowledge organisation to manage information and information processes to empower information work?

The short answer to the question is positive. According to the findings of this study, the virtual realities do bear a significant potential in addressing some of the most critical issues of the information work in the studied context of archaeology. The framework offered by the virtual realities is clearly ill-fitting in uniform procedures and in a linear routine work. However, it is a potentially powerful instrument in empowering complex, contextual and situated interpretative work. These qualities are typical in the many instances of the archaeological information work. The qualities are especially prominent in the work roles, which encompass fieldwork, academic research and cultural heritage policy work, and where the essence of the activity reside in broad participatory information interactions, in the complexity of the information horizon and the versatility of the information behaviour.

9.2.1.2 How would an eventual virtual reality based knowledge organisation map for the different aspects and types of information work?

Work, information work and knowledge organisation constitute a cyclical system. The structures and organisation of the information work warrant distinct kinds of knowledge organisations, which subsequently afford and constrain distinct types

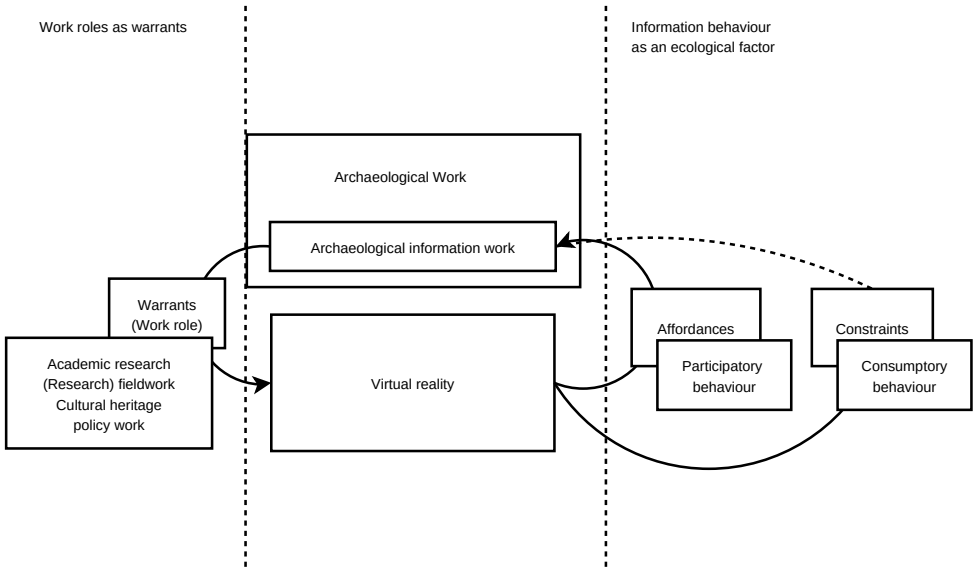


Figure 9.1: The ecology of the virtual reality based information work and knowledge organisation

of work and information work. The present study has demonstrated how the information work analysis and the resulting work role descriptions (consisting of CATWOE, use case and information horizon analyses) may be used as an organisatory warrant for determining the requirements of a planned knowledge organisation system or the feasibility of adapting an existing system (Fig. 9.1). The information behaviour functions accordingly as a complementary workable factor for explicating the ways of working with information, which the knowledge organisation system either affords or constraints, depending on its characteristics (Fig. 9.1).

The present study referred to the archaeological information as an exemplary domain of information work and to the virtual realities as an exemplary method of organising knowledge. The findings point out that the virtual reality based knowledge organisation is *warranted* by extensive and, to a degree, by intensive, participatory information work, which is present in the academic research, fieldwork and cultural heritage administration work roles. Besides the work roles, it became apparent that the virtual reality shows considerable potential as a provider of a basic knowledge for entering a work role (i.e. in assuming an understanding required in participation and in the participatory information behaviour within a context). On the other hand, the analysis concluded that the virtual realities do *constrain* a consumptive information behaviour (Fig 9.1).

The findings support many of the earlier suggestions and assumptions of the potential usability of the virtual realities in the archaeological contexts. The obtained indepth understanding of the relations of the archaeological work and the notion of the virtual realities did, however, point out and emphasise the salience of several important issues. Of these, the notions of the contexts and situatedness, the ecology of the meaning and the paradigms of interaction and life-cycle are discussed in detail in the following conclusions section (ref. Section 9.3).

In the archaeological literature, the virtual realities have been seen primarily as visualisations, which are capable of serving the scholarly community and es-

pecially the public audience. The present study has pointed out that the virtual realities are potentially capable of serving both the scholarly and the professional communities and that a virtual reality does not need to be a mere visualisation. The focus on the work of the archaeology professionals limited the general public out of the scope of the present study. However, in the different interfaces of the discussed work roles, the information work analysis made occasional references to the actors outside the professional archaeology. According to these instances, it may be concluded that the virtual realities may serve as a potentially usable mediating knowledge organisation system between the professionals and the general public. The complexities involved in these efforts do, however, reach far beyond the problems of constructing an accurate representation of an archaeological object or a structure.

An assumption, which preceded the analysis of the linkage between the information work and knowledge organisation was that their relationship is cyclical. The knowledge organisation is likely to be warranted by the information work related to the information behaviours, which are consecutively afforded by a similar kind of knowledge organisation. The results were largely in accordance with the expectation that the virtual realities are warranted by a research oriented information work and that they subsequently appeared to afford participatory i.e., broadly speaking, research oriented information behaviour. Because the warrants represent the structural factors of the work and the information behaviour is a personal trait of the workers, the cycle was expected to show, however, some variation.

The most visible instance of variation was related to the antiquarian work role. The informants whose duties comprised the work role appeared to be rather sharply oriented towards the intensive participatory information behaviour, albeit the work role did not seem to warrant the use of virtual realities. The anomaly is explained by the tendency of the antiquarians to work with collections of information instead of functional sets. An antiquarian participates intensively in the institutional information repository i.e. the collection management system, both by using it as an information source, and by contributing new information.

The observation leads to suggest that the qualities of the virtual realities do warrant information work, in which the purposes, meanings and values are centred around the notion of a common intellectual context, rather than a common material object of interest. The emphasis on actualising knowledge organisation through engagement, interaction and dimensionality does not benefit situations where the focus of the activity is already actual and available (like in the case of inspecting a find in its original context).

Besides the anomalous work role of the antiquarians, the material also revealed anomalous work procedures. Contrary to a plausible expectation, several instances of complex information work processes seemed to occur in most of the identified work roles. The decisive reason for this anomaly seemed to be the general inadequacy and incompleteness of the available information repositories. It is likely that the individuals associated with these work roles would have been inclined to use more linear and incomplex information repositories and knowledge organisation schemes if they would have been available.

9.3 Conclusions

9.3.1 Towards professional information management in archaeology

The present study has pointed out the significance of the information work in the context of archaeological work and suggested its general constituency in the context of any individual instance of work. A maintenance of the pertinence of an intellectually and practically efficient, fit and sustainable information work is not only a means to empower the practise of archaeology in its diverse contexts, but also a means to maintain the scholarly motivation for studying and excavating the remains of the human past.

It is apparent that the archaeologists need increasingly thorough education in the information management. First of all, it is important to raise the awareness and understanding of the significance, and subsequently of the principles, of effective management practises. Besides providing a necessary theoretical basis, it is equally constituent to give the archaeology professionals a basic competence of the elementary techniques of managing information. In addition to the basic professional and academic education, it is apparent that there is a need for a group of information management specialists with a thorough understanding and experience of the archaeological frame of reference. Both the small and the large institutions and projects would be likely to benefit of a contribution of an information manager, who has developed a solid competence in information management and in the intellectual and professional practises of archaeology.

9.3.2 Systematics of the complexity: information work as a soft system

The principal methodological contribution of the present study is the development of a framework for studying human information activity based on the notion of information work and called *information work analysis*. Information work is perceived within this framework as a life-world wide phenomenon, which is incorporated into every instance of human work from simple assignments to complex intellectual tasks. A focal aspect of the approach is that it grasps the informality of the observable practises of information work and the formal infrastructural systems of knowledge organisation in to a single conceptual framework. In accordance with its theoretical background in systemics, the framework collates human actors, information and information infrastructures within a single ecological 'soft' system. The system bridges the informality of human activity and the formality of the artificial structures and provides means to understand the information work and to use the attained understanding for its management. On the basis of the attained outcomes of the present study, the framework may be argued to provide improved means to empower the development of practicable knowledge organisation schemes, and subsequently, workable information systems. The results of an information work analysis do not reveal a direct layout of an optimal management strategy, but they do establish a solid basis for founding infrastructures and information systems on the information work they are supposed to endorse.

The primary contribution of the systems approach is to help to bridge the gap between the descriptive, user studies oriented information behaviour research, and the practical development and management of information and organisations. The

level of perusal is intentionally abstract and descriptive compared to a directly development oriented requirements analysis. Simultaneously, in the behavioural perspective, the present approach is technical. The models are derived thorough a qualitative understanding of the studied phenomena, but the understanding is abstracted and formalised in a manner, which allows further elaboration and precising required in meeting the requirements of the practical and technical management work.

The bridging of the gap between the two polarities of the behavioural description and of the formalism are proposed to be possible by using a technique, which approaches the problem from the both ends. The present study has used a rigorous anthropologically informed analysis of qualitative data to describe the user behaviour, which is based on a multifaceted set of descriptive and analytic methodologies. The description has been analysed further from a soft systems point of view. The systems oriented examination of human activity has been finally combined with a classification and specification of relevant structural and infrastructural information artefacts and interactions, using the classification of Cool and Belkin [186], and Sonnenwald's theory of information horizons [707] (ref. also Sonnenwald, Wildemuth and Harmon in [711]), as a theoretical framework. The attained understanding serves as a starting point to proceed further, beyond the scope of the present study, towards a technical specification, which is directly usable in the technical design and development of an information system. In practise, this process involves a series of iterative transformations, which operationalise the present models further. Mobach et al. point out that the applicability of the root definitions in systems design may be enhanced by placing more emphasis on making the CATWOE descriptions less abstract, and further by placing more emphasis on the normative rigour and evaluation of the model [532]. A similar concretisation is suggested for the rest of the models discussed in this study.

The findings of the present study do, however, underline the necessity to first obtain a general conception of the broad work processes and their purposes, meanings and values. It is quintessential to start the process of refining and reducing abstraction only after the broader understanding has been established. It is argued that increasing the detail, formality and evaluability of a root definition does necessarily increase its contextuality. Subsequently, the distinguishing of the important issues of the work from the important issues of the work context becomes difficult. A new computerised information system or new management practises may thus end up serving the needs of the individual archaeologists on the basis of the present human system, rather than the needs of the entire community, which is pertained to the landscape of the archaeological information work. Therefore, it is argued that an eventual shift towards formalism needs to be careful in order to avoid the loss of a necessary breadth and depth of the perusal, which is constituent for the understanding of the complexities of human activity. Consequentially it is important to set the focus of the investigation first on a level, which is abstract enough. Only then the analysis may succeed to reach the issues related to the purposes, meanings and values instead of merely touching upon a set of consequential details of the everyday work.

9.3.3 The contexts of archaeology and virtual realities

The first apparent yet highly complex issue of convergence between the archaeological work and the virtual realities is the phenomenological difference between

the archaeological realities and the virtual realities. The fundamental aspect of archaeological information objects and knowledge organisation systems including reenactments, reconstructions and constructions is that they effectively reach out of archaeology (Section 8.1). They seem to be difficult to grasp by an archaeologist, because they are no more any archaeological subjects. A reconstructed archaeological landscape is beyond the scope of study and evaluation by using the traditional methodological and mental tools of the archaeologists. The notion showed up prominently in one interview. The informant described a situation where she had to work with a far more complete site she had ever been working with [A]. The phrasing of the questions, motivations and methods had to be formulated anew to conform the exceptional situation.

A claim that reconstructing and visualising archaeological sites and their past appearance is something new, is not entirely correct. The earlier models moulded of the Plaster of Paris, and the artistic illustrations of archaeological subjects are in a technical sense an obvious form of analogical virtual realities. Besides entities we readily denote as models, a multiplicity of other realisations bear resemblance to the virtual realities. In the essence, a museum exhibition is a virtual reality kind of a representation of an archaeological subject. Constructing virtual views to the past does not necessarily confine itself into the formation of visual representations. A textual description may also be considered to be a reconstruction of the past, which is realised using a single media form. In the broadest sense of meaning, every book and article might be seen as a virtual reality in the resonance of a multidimensional information infrastructure. The virtual reality may be a complex information system or a static visualisation, and function both as a structure and infrastructure for the information work, and as an infrastructure, which essentially empowers the work.

The problems and uncertainties expressed by the informants of the present study (Section 8.6.1) and repeated in the literature on the archaeological virtual realities, seem to focus on the notion that a visualisation is something new and unknown compared to the present forms of media used to mediate the scholarly and professional information. Zhukovsky introduced a concept of *archaeoreality* to denote a virtual representation of an archaeological site [853]. In the light of the findings of the present study, the concept is potentially useful, because it underlines the *archaeological* nature of an *archaeological* virtual reality. The representation is a virtual version of the site and its significant aspects, but it is also an archaeological version of the site as it was in the past and at the moment of investigation.

The tendency to alienate the virtual realities beyond the horizon of other aggregate interpretations such as archaeological representations may be seen as a counter reaction to the opposite idea of seeing the virtual realities as 'natural' environments of interaction. The 'naturalist' assumption attempts to take advantage of the seeming similarity of the virtual environments and the natural environment. A sophisticated version of the assumption is the "natural scene paradigm" proposed by Hoffman and Grinstein. The paradigm attempts to take an advantage of the assumption that because the human perception has evolved in nature, it would be naturally optimised for identifying and extracting such features, which are present in the natural environment [386, 70-71].

The immanent problem of the natural scene paradigm is in the diversity of the natural environments. A Finn is used to the Finnish environment, which differs quite radically, for example, from the Australian one. Some physical characteristics of the natural environment might be expected to bear some physiological meaning

(e.g. directions up and down, location of the sun in the sky, green colour of the vegetation), but whether the characteristics provide a broad enough basis for complex information management tasks remains to be determined. An assumption, which underlies the paradigm that the perception of each individual is purportedly well tuned to work with its familiar environment is, however, of a more prominent interest. It turns the attention to the vagueness of the borderline between the novelty and the similarities of virtual realities with the currently used media forms. The interface between the new and the old is being exploited in the process of *non-photorealistic rendering*, which refers to a set of methods for deliberately producing images, which are not lifelike. The images are given instead, an artistic look, which may resemble, for instance, a pen and ink drawing or an aquarelle [509][743]. The method has been used in explicating the assumptive nature of the surroundings presented in virtual realities [446][643]. The approach retracts the possibility of hyperrealism and the potential dimensions of communication mediated by another kinds of texture, but achieves simultaneously a new dimension of communicating trust. Non-photorealistic rendering does not produce results, which are 'natural like nature', but attempts to refer to the kind of engagement known from the fine arts .

The virtual reality related 'natural' might be better understood in the 'virtual real' (Section 3.2.2) sense, of pertaining to the context of the present activity or work, instead of being 'natural like nature'. The role of information work analysis and the investigations similar to the imagination exercises used in the present study, becomes accentuated as means to reach the 'natural' in the combined context of virtual realities and the information work. The combined context needs to accommodate the notions of dimensionality, interaction and engagement, and the central aspects of the concerned activity. In this particular sense Gillings puts an important emphasis to the development of archaeological virtual realities, which are founded on the archaeological theory and practise, instead of being premised on the technology [317]. Similarly the emerging technologies and the education of their users should be directed towards bringing distinguishable benefits beyond the level of an academic discussion and prototyping. Constructing a functional virtual reality in the everyday context of work [317] enjoins thus a thorough understanding of all the constituent aspects, including technology, archaeological theory (i.e. the intellectual premises of archaeological work), and the archaeological work itself in a broad context, which embraces its purposes, meanings and values. Basically the notion relates to any environment, because all context-actor –relationships are dynamic in the sense that both the landscape and the actors participate in an activity. Virtual reality empowers to combine the generic interplay between the actors and their contexts with the notion of 'ambient intelligence' to bring the directed activity related purposes, meanings and values to be a part of the context. In an intelligent landscape like a virtual reality, also the infrastructure (i.e. the virtual reality), besides the human beings, fosters its own instances of information work.

In the essence, the notion of a virtual reality represents a combination of something new and something old moulded together to form a new context for the information work. The findings of the present study suggest that a careful consideration of the cohesion between the different virtualities, realities and media forms is needed in order to establish a solid picture of the new landscape. A working result anticipates a combination of the analytical explication of the information work, a deep familiarity with the technology, and an indepth understanding of the users and their conceptions of the virtual realities. The attained understanding may be

turned to a working level of standardisation of communication in the new context. It is important that the consensus reaches a point, where the different spheres of interests and needs coincide in a manner, which affords a fruitful cooperation between the different individuals, groups of human-beings and systems of knowledge. The explication of work and information work processes is needed to bring the different actors together. At this precise point, the present study may contribute to the infrastructural standardisation of virtual reality based knowledge organisation and to the question of the premises of the standardisation. A virtual reality infrastructure might be used to enforce the existing patterns of work, or to change the organisation of knowledge, or both, if it would seem to be beneficial in the archaeological information work.

9.3.4 The emergence of complexity

The only difficulties of the archaeological work are not the communication between the contexts and the recognition of the existence of relevant information. The closeness of the novel and established knowledge, and the apparent similarities between the landscape of virtual realities and the old forms of mediating information imply a double problem. The mastery of the present media and the comprehension of the consequences of its use in a new context, are not axiomatic. As the present study clearly points out, the mastery of the present media does not necessarily lead to its optimal use from the media or the information point of view. Work tends to be focussed on practical issues and closely related motivations, such as "a project needs to be finished in schedule".

A central notion about the virtual reality worlds is their seeming, yet not necessarily actual closeness (ref. Section 9.3.3) to the 'real' world, which is mastered implicitly without an explicit effort by most of us. Development and learning of the technical, social and mental controls are needed to create a sense of trust in a virtual reality and in its natural laws. The findings of the present study suggest that controls are needed to make the functionality of the virtual reality explicitly and implicitly understandable and consequently trustworthy from the point of view of a user-actor. First of all, solving the jigsaw puzzle of coherence in the context of virtual realities is still of a primary importance, as Forte urged already in 1998 [281]. The process involves discerning how much an author trusts on the different elements located in a virtual reality [19]. The development of measures, including the fundamental philological and technical conventions, proposed by Frischer et al. in the so called "CVRO manifesto"[1] would be a necessary beginning for consolidating the use and understanding of the virtual realities in the cultural heritage sector [291]. Similarly the proposals of establishing and advancing general archaeological terminology projects are of importance [83][219]. In spite of the descriptive power embedded in the linguistic metaphors, they may be argued to miss an important point in the context of both the virtual realities and especially of the archaeology. Neither the infrastructures of virtual reality nor the archaeology communicates solely in terms of a language, but constituently also in the terms of a physical existence, a sense of presence, interaction and a dimensionality. A visit to an archaeological site and to a virtual reality environment is an act of going and being there, which is not substitutable by a description of what happened. The description i.e. the linguistic terms are placed on the subjects after the first impression to make it possible to verbally articulate the experience. In this respect

[1] CVRO for "Cultural Virtual Reality Organization" [291].

the principal interest of the archaeological knowledge organisation might indeed be in the developing of appropriate infrastructures for networking and managing the emerging information interactions, instead of investing heavily on affixing the fluid terminologies (ref. Section 8.5.2). The act of construing the infrastructure may be expressed in philological terms, but the organisation of the semantic symbols might be better explicated as an architecture of the infrastructure. The actors communicate not only by an explicit exchange of messages, but by explicitly 'being' within the infrastructure.

The perception and language of virtual realities is not merely an issue of mediated expression and communication. The virtual realities are functioning in real-time for an individual, but they do empower real-time expression also in the context of groups. Tagging the social dimension means tagging the virtual realities as an information space shared by all the participants in the community of collaborators (Section 8.6). The environment is perceived and understood simultaneously in multiple terms by the different participants, because they reside necessarily on the different axial instances of the landscape of knowledge (Fig. 8.1).[2]

The findings of the present study support the argument of Forte that the effect of increased complexity may also be a positive one [282, 11, passim]. The notion of the frames of reference referred to by Forte originate from cybernetics and denote an interface between ontologies and subsequently, in the context of the present study, between systems of knowledge organisation [282, 11, passim]. Barceló has proposed accordingly that the process of simulating the past using a virtual reality resembles the human process of understanding incomplete sensory information [54] (on archaeological simulations, ref. [55]). The points of convergence of the archaeological information work and virtual realities have been demonstrated to be deeply participatory and complex (Section 8.6). As a virtual reality multiplies the frames of reference, it catalyses information processes to the further levels of learning. Zanini has proposed a similar catalytic effect concerning the use of multimedia presentations in archaeology. The new instruments and structures of presentation compel a thorough reflection of the methods and strategies of the archaeological information work [851].

In the light of the findings acquired during the present study, the multiplication of the frames of reference might be considered to be significant in two distinct senses. The virtual reality may act as an instrument of creating new, both literal and theoretical, perspectives to the information. This was implicitly suggested by the informants, who were interested in enriching archaeological documentation and literally rotating objects. The second sense of the multiplication relates to the increased complexity of the knowledge organisation system, which coerces its users to put more effort in the interactions. The basic qualities of the virtual reality (engagement, interaction and dimensionality) may be considered to underline the complexity instead of simplicity in comparable manner to the indicative findings of the Westerman et al. study [820], in which the increased dimensionality of the representation deepened the interactions with the infrastructure.

An important issue discussed in the present research is that the virtual realities do indeed multiply the number of frames, but in doing so besides enable, also complicate the processes of information and learning. In a sense the malaise of virtual realities and archaeology and in more general terms of the virtual realities and information work, is the practical difficulty of interfacing. Information work

[2]The Brown et al. [122] study on collaboration in a hybrid environment points out some further possibly emerging issues regarding the collaboration in a novel environment.

needs to be interfaced within the framework of its purposes, meanings and values with the relevant actors and resources. Only then a virtual reality may act as a facilitator. The virtual reality may act, however, also as a hindrance, if it is not understood and used in a compatible manner with the realities of the past, the virtual, the information work and of the archaeologist.

9.3.5 Meaning in making in the virtual realities

The temporally concurrent emergence of knowledge and the consequent ecology of information work infrastructures is not a haphazard process. The collective discourse within the community of archaeologists and the subsequent emergence and evolution of information infrastructures, may be argued to be taking the shape of *collective learning*. The concept has been used by Christian to denote the adaptive mechanism of sharing and accumulating knowledge. The process is described as being amorphous, diffuse and lacking definable borders [168]. Collective learning is in a sense an evolutionary process. Compared with the genetic information, the cultural one is easier to exchange and it can accumulate:

> "*[a]s human numbers have increased, the pool of shared knowledge has expanded, and the mechanisms for preserving knowledge have become more and more sophisticated. This is why collective learning can outpace and eventually override natural selection, and why the significance of cultural change is bound to increase over time*" [168].

The relevance of the collective learning in the context of the present study, is in its capability to address the notions of diversity and continuous change. This change is not entirely random, but it is expressed in patterns, which are enormously difficult to discern, describe and anticipate. The present study suggests that the information work analysis and the notion of work roles may provide a tool for studying the ecology of information work and the embedded knowledge infrastructures within the framework of the collective learning. The information, knowledge, their representations and the consequential perceptions evolve all the time and exist in numerous instances in the multidimensional continuum, which builds up in a virtual reality.

When thinking of a virtual reality information system aimed to communicate, but also to store heterogeneous material for further presently unknown analytical use, setting clear objectives or foreseeing even broader scope of the possible information behaviours of the users could be argued to be an impossibility. Computer games, which incorporate virtual reality settings, are in this sense an illustrative point of comparison. On the one hand, as Anderson emphasises, the game industry offers attractive technologies and tools for creating complicated and technically advanced virtual environments [26][28][27]. On the other hand, the computer games may be reflected as a distinct paradigm of presenting and making information available. Compared to a virtual reality information space, a game may be significantly more usable, but only inside the special frame of interpretation of computer games [172]. The reason for the perceived user-friendliness may be traced to the well managed goal settings and internal dynamics of a game environment, which are creating and supporting the, as such, difficult to control social-subjective entertaining function [387]. As Smed and Hakonen observe [698], in a game, the freedom of choice is illusory. By contrast, in an open information management system, the possibility to choose ought to be real. Despite the paradox of indeterminacy and the difficulties in finding clear objectives and needs, it is a matter of

importance to try to analyse the context as meticulously as possible to meet directly at least some of the most probable needs [197]. Otherwise the system faces a danger of becoming completely pointless.

Assessing implicitly existing potential of needs and motivations is demanding as noted already. Consideration of the computer games does, however, reveal one further problem, which is related to the conditional existence of an explicit need. In a case of an information system meant to be used also by the general public, the concrete need of information as such, is often rather blurred by the entertaining function of a walk around the historical town area. Therefore the design should be able to cope with a situation where the information is expected to be used for a purpose, which is strikingly different from its original or intended context of use.

Fencott makes an interesting further observation concerning the convergence of computer games and virtual realities. He claims that the virtual realities are attractive largely, because of the users' awareness of the effort of making sense of the other reality. The perceived importance of the effort of making sense may substitute almost completely the outcome as is the case in the computer game Tetris. In Tetris, an isolated jigsaw puzzle piece may be argued to be meaningless as such. Instead of the content, the effort of placing the pieces in a stack, is the heart of the whole activity [265, 92]. In archaeology, an individual piece of evidence is similarly more or less meaningless, while the work of finding out the combinations, either in an explicit research project aiming at a publication, or more implicitly, as an archaeologist's personal effort of constructing identity. Unlike in Tetris where an individual piece of the puzzle is *de facto* lacking meaning, the isolation of an archaeological find depends on the scale and scope of perusal. For one pottery expert a sherd might be a relatively atomistic notion, while her colleague working with chemical analyses might consider the chemical composition of a sherd to provide it with another level of meaning. Kantner refers to the same primacy of process versus results when discussing the potential of virtual realities in archaeology. The current study does reinforce his argument that the principal research use of virtual realities would be creating rather than using them [431]. In this respect, the relevance of reaching a formal understanding of the meaning becomes subordinate to the understanding of the process. The usage and consultation aspects may not be totally discarded, because of the need to retain a continuity of the information work. The need of actively tendering the creation of meaning and providing an engaging process places, however, considerable demands on the infrastructures. It is there where the computer game like mechanisms of meaning creation show considerable promise.

The relevance of discussing an eventual language of virtual realities, a notion of collective learning and computer games in conjunction with the present study is that they form a set of viewpoints, which help to explain the manner in which the virtual realities may contribute as a knowledge organisation infrastructure to the processes of archaeological information work. The present study has on the one hand demonstrated the prominence of complex, processual, participative and communal information interactions in archaeology and on the other hand the alignment of the virtual realities to support such an activity through the elements of engagement, dimensionality and interactivity. The focal issues of supporting the collaborative process of making meanings, are to find the point of convergence for the representations of the information work in the new landscape, establishing a conceptual level understanding of the process how the collective representations change, and to establish a parallel how to master the process itself. The constituent argument is

that the virtual reality needs to function as a 'game' of collective learning, where all the participants are challenged to actively shape the meaning of the environment, which is a system of knowledge organisation. The game is in constant motion, it is actively shaping the meaning of involved information and opening new avenues for keeping the information work in a state of alteration. The playing of the game is constricted by a set of constantly changing rules, which actually turns the purpose of the game to finding out and keeping in pace with the alterations caused by the intervention of one player and that of the others.

9.3.6 Hunting in the virtual wilderness(es)

Like a virtual reality might be seen as a computer game, which challenges the players to seek out the dimensions and natural laws of the environment, the activity of seeking has its own parallels. The characteristics of virtual realities, engagement, interaction and dimensionality, are reminiscent of the 'anthropological' information behaviour metaphors related to foraging [561, 126-135][658]. The fit of different foraging strategies was briefly discussed in section 7.3.1, in conjunction with the information behaviour groups identified in the empirical data. It appeared that the 'customers' tend to resort to a set of indefinite and passive strategies such as grazing, satisficing, collaboration, bricolage, scavenging, and sitting and waiting. 'Participants' on the other hand are more active hunters, pickers and couplers. Intensive actors tend to prefer systematic strategies such as indexing and berrypicking over the more random ones such as browsing, which are preferred by the extensive actors.

The aspect of the archaeological information work, which seem to be best supported by the notion of a virtual reality system resemble the foraging of animals or early hunter-gatherers. Virtual realities *afford* foraging alone and in groups. Because a virtual reality is fundamentally an engaging, multidimensional and interactive entity, it permits several ways of approaching the information and reaching the relevant items from the information work point of view. At the present, the archaeological information work involves foraging mostly due to the inadequacies of the available infrastructures. In an ideal situation an extensive information behaviour is related to the extensive forms of information foraging [561, 126-135], while intensive users should be able to pinpoint the required information more or less directly by explicit queries.

The graphic image of a three dimensional virtual reality system leads easily to consider foraging in a very concrete meaning. Virtual reality would be a natural human environment, where the information hunters seek for their prey. As already discussed in section 9.3.3, the virtual wilderness is not automatically known or natural for an information forager. Similarly, the realisation of engagement, interaction or dimensionality does not need to follow the notion of a hunt in a literal sense. The important factor is to be able to support the formation and pursuance of similar information use strategies, which make the foraging effective in the wilderness. It is important to note, however, that the notion of empowering foraging does not equal with the "making something available" kind of passive information sharing, which prevails in the archaeological documentation. The virtual reality has to be consciously built to function as a memory device (ref. [850]), which helps the human-beings to edify an appropriate knowledge. The infrastructural dimension of the knowledge organisation needs to be specifically considered and warranted to afford foraging style interactions.

Despite the conscious proscription of a direct comparison between the virtual and natural environments, a virtual reality may contribute to the information work by mediating individual characteristics from 'real' contexts. In the context of archaeology such a characteristic might be the physicality of the archaeological material, which bears a constituent meaning in the archaeological information process. The relevance of physicality seems to expand to the deliverable. The physicality, which is sensed at the moment of finalising a research effort, is a concern in a virtual reality mediated information work. In a limited manner it is maintained through the possibility of opening a web page on a public server were the deliverable is located. From the point of view of virtual reality environments an imminent risk of loosing the concretia of deliverables does exist. Therefore it seems feasible to suggest that constructing a mechanism of anchoring each contribution to a place is a matter of importance. Similarly a possibility to discern and figuratively touch upon individual contributions in a mass, seems to be important for the archaeologists.

9.3.7 Virtual reality as a life-cycle of information

The most important contribution of discussing the virtual realities in an information management context culminates in a general observation that unlike the more traditional systems of information, a virtual reality grasps the whole life-cycle of the information: its creation, use, sharing and application. Similar to the notion of information work, the knowledge organisation is an organic part of the practises of work. Work maintains and is maintained by infrastructures, which are resident in the knowledge organisation and contribute to the emergence and life of the collective learning within the scope of the particular work horizon [168].

In a virtual reality, the infrastructural dependence and the emergence of the knowledge organisation embeds it into the life-cycle of information. Information is being created, organised and used concurrently in a virtual reality system without a clear distinction between the individual phases. Following the notion of Giddens, a virtual reality may be seen as a structure, the information work as a system and their interaction as the process of structuration. In contrast to the theory of structuration [315], the division of the structure and the system is not altogether unequivocal, even though it is discernible. Information work manifests in a virtual reality undoubtedly in the same manner as in static and less embedded contexts. Only the sequence of the actions becomes blurred due to the dynamic nature of the virtual realities. Virtual realities emphasise a sprouting diversity and a need for holistic competencies in the information work. Both notions are closely related to the attributes of all digital information and communication systems, although they seem to accentuate in the virtual realities. The tendencies of increasing the differentiation and broadening of the required competencies has been underlined both in the visionary postmodern debate on the new milieus of media, and in several recent studies of information professionals and information related work in various contexts [2][530].

The virtual reality permits a non-linearity of information infrastructures and underlines the role of complexity as an essential part of an information processes. A virtual reality system is an instance of a 'soft system', which enables the actors to come closer to the work processes and human information processes present in the natural world. In a sense, a virtual reality is capable of bringing the interrelated notions of work and information closer together than is possible in other systems. A virtual reality acknowledges and enables also less optimal and satisficing tar-

gets of the information interactions in course of the process. The interactive nature of the virtual realities is inclined to empower collaborative and social information behaviours and illinear processes, where the progress consists of sequence consecutive successes and failures. A virtual reality also permits the management of the iterative nature of the information processes, the situatedness of the iterations in multiple sessions and the multithreaded tactics in the information interactions. It may be used to underline the importance of evaluation and feedback and to support the internal-to-the-system construction of the new representations independent of explicit implementations. The role of an information manager in a virtual reality system is more of an expert, who works to ensure the persistence and continuity of the information process, than the one of an information retrieval specialist [561, 145-148].

In a virtual reality environment, the notion of information life-cycle may be used to denote both intraorganisational and interorganisational processes. A typical conception suggests that information is created, disseminated, organised and utilised in a matrix, which consists of entire human societies. Books are written by authors at home, published by publishing houses, disseminated through bookshops, organised by libraries and utilised by us. The evolution of digital information, global networks and the worldwide connectivity have turned the emphasis on bringing the entire process onto personal desktops. The life-cycle may be shared in the different parts of the world and the process can be made available within a single framework and an interface for an entire community of people working together.

It is not clear how this transition will be affecting the contemporary memory institutions. Hazan [356] discusses the virtual communities in a DigiCULT position paper from a memory institutions' point of view. The collaborations may be built around the present cultural institutions, but not necessarily. The observations made during the present study on the social and formal organisation of archaeology suggest a parallel institutionalisation around communities of information work on the level of its purposes, meanings and values. The upkeeping of the material artefacts demands the existence of physical repositories, but their continuing existence does not necessarily have to impede the emergence of 'knowledge organisations' built around the shared notions of work and information work instead of a common physical space. The communities do not need to be separate from the existing institutions nor do the communities need to be new *per se*. The distinctive characteristic of this process is how the participants attach themselves to the institutions and how they explain their membership in the community. Instead of belonging to the community of users of the services provided by a distinct institution, the individuals might identify themselves belonging to a group, which uses a relatively homogeneous set of resources provided by several separate institutions.

The constituent issue, which affects the success of a life-cycle, and the fitting of the virtual realities together with information work and processes, reside in the identification and command of the infrastructural characteristics or dimensions, which constitute the functionality of the virtual realities in different contexts. The focal question is how to realise the virtual reality and its constituent elements of engagement, interaction and dimensionality in an efficient and sustainable manner. At the present, the maintenance of the virtual realities denotes only the sustainable storage of the structural characteristics of a virtual reality, and in best case, a 'bag' of associated metadata. The information in the form of engagement, interaction and dimensionality, which is the real surplus value of the virtual reality infrastructures, is not preserved at all. It is true to the archaeological information work and to

virtual realities (and their joint use) that the issues are largely social (ref. [308, 61-62]), but not entirely. The social is intertwined with the infrastructural organisation, management and the life-cycle of information.

The structures of knowledge organisation need to attain a working level of standardisation to permit the communication of engagement, interaction and dimensionality through and between the different instances of virtual realities. The efforts such as the standardisation coordinated by the UCLA Cultural Virtual Reality Laboratory are tackling with this issue [290][289][3]. It is, however, an essentially broader issue than the mere notion of finding a standard representation for a three-dimensional graphic model. The realisation of the standards is hindered by the complexity and diversity of the creation of meaning and the perception of the environment as an individual and as a collective process. Barceló argued in the late 1990's that the current technologies were far more complex than the actual questions [54]. The observation is important, yet it might be seen in the light of the findings of the present study as a symptom of an imparity between the technologies and questions, rather than as a straightforward issue of exceeding complexity. The perceived simplicity versus complexity indicates an incapacity to articulate the complex questions in terms of the possibilities offered by the technologies, but also of the coexistence of different kinds of complexities.

The functioning of the infrastructure is dependent on the convergence of the Benediktian *extrinsic* and *intrinsic* dimensions of the knowledge organisation and of the work (ref. Section 3.2.2.6). The dimensions are fluid, complex and they function during the information work closely embedded in the general framework of knowing and being informed. Considering the findings of the information work analysis, it seems plausible to state that the distinction between the Benediktian dimensions is possible in the context of work and its constituent work roles. Besides the notions of spatiality and time, the archaeological work shares a generally intrinsic, but within the context of archaeology, an extrinsic dimension of communality, politics and authority, which pertain and shape the infrastructure and forms the framework of the discipline. Consequently, in the general context of the archaeological work, the complementary aspects fall to the category of intrinsic dimensions, which represent the information embedded within the infrastructure.

The necessary fit and sustainability of the resulting infrastructure are constructed on course of the activity of an individual and social foraging, which subsequently turns into an ecological process of collective learning. By supporting, and essentially being a part of, the enterprise of 'collective learning', the virtual reality may become the 'objectifying resource' (the common ground) of the infrastructures in an ecological game of foraging, which is called 'the archaeological information work'.

9.4 Contributions of the study

The present study has three major implications, which contribute to the research and practise of information management, knowledge organisation and archaeological information work:

1. The study **presents an approach based on the systems theory titled as 'information work analysis', which assembles the notions of work, information work and knowledge organisation infrastructures to a single framework.** The approach incorporates **a common ecological framework to expli-**

[3] Presentation on the programme also in LIDA 2005 conference (Dubrovnik, Croatia).

cate both the qualitative understanding of the information work and the formality of the knowledge organisation systems, which makes it possible to bridge the two notions. The new perspectives to the integration of information behaviour research, information horizons theory, work studies and information management may be utilised in forthcoming research efforts. **An important element of the information work analysis is the assumed perspective to see 'information work' as an integral part of every instance of work and human activity**, not as an isolated pursuit forwarded by a group of specialist information workers.

2. The investigation explicates a set of qualities related to the information work, which afford using the notion of virtual reality as a basis for knowledge organisation. The findings suggest that **due to their complexity, the virtual realities are beneficial in complex instances of information work, where the information is fluid, contextual in several dimensions and in a state of making and where the information work combines several contexts of the work and grasps the entire life-cycle of the information**. In the case of linear and well determined information work, the use of virtual realities is suggested to cause unnecessary lag. The findings contribute to the decisions of adopting or not adopting virtual reality based information and knowledge organisation systems to the specific instances of work by providing necessary background information.

3. Finally, the study **presents for the first time a concise analytical description of work and information work within the domain of archaeology from an information science point of view.** This understanding may be used directly for the benefit of the development of the information management strategies and information management systems for archaeological purposes. The findings may be used accordingly to also inform the future planning, administration and research of cultural heritage information services.

9.5 Recommendations for further research

The present study is an analysis of the ecology of information work and knowledge organisation. It is a bridge between the informal patterns of work and the formalism embedded in the notions of organisation and management. The acquired understanding provides a solid basis for empowering the management of archaeological information and information work in the future.

The most important of the practical implications achieved and a path for further research, is the possibility to begin to work with research frameworks attempting to functionalise the understanding and requirements explicated in the current study. It would also be possible to analyse the existing systems and realisations in the contexts of the present findings and to see whether they actually support purposes, meanings and values of the work in the light of the understanding attained in the present study. Interesting follow-up questions would be

1. how the present knowledge organisation systems are used in conjunction with the ecology of the patterns and organisation of work and information work,

2. how the existing virtual reality systems are being used in terms of knowledge organisation,

3. how the information work analysis and the present ecological approach to the information work and knowledge organisation might be developed further, and

4. what kinds of implications the information viewpoint, information work analysis, and the framework of information work and knowledge organisation have on the discipline of information studies and its methodological, theoretical and epistemological foundations?

Another implication of the present study relates to the assumed framework of studying work and information work in conjunction with the notion knowledge organisation. The earlier acknowledged need [577] of conducting exploratory studies of domains and user groups, and eventually running tests in user organisations was emphasised in the course of the current investigation. This study has contributed to the issue within the domain of archaeology and cultural heritage, and simultaneously opened interesting avenues for proceeding with efforts on other domains and contexts. It would be tempting to apply the information work analysis to the study of the information work in other information and knowledge intensive fields of work. Equally interesting prospects may be found in matching other kinds of traditional and non-traditional frameworks of organising knowledge to the various instances of information work.

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Part IV

Appendices

Appendix A

Letters of invitation

A.1 Finnish language version used in Finland

Arvoisa NN,

Tiedustelisin ystävällisesti olisitteko käytettävissä haastateltavana tutkimusprojektissa, joka liittyy arkeologisen materiaalin dokumentoinnin ja arkeologisen tiedon tietokonepohjaisen varastoinnin ja käsittelyn kehittämiseen. Projektin päämääränä on luoda ja testata konkreettisia menetelmiä, joiden avulla arkeologisen tiedon hallintaa ja arkeologin työtä voidaan aivan käytännössäkin helpottaa tulevaisuudessa.

Haastattelun tavoitteena on selvittää arkeologien ja arkeologisen kulttuuriperinnön kanssa työskentelevien tapaa hankkia, käyttää ja tuottaa tietoa, sekä kartoittaa suhtautumista tietokonegrafiikkaan ja sen mahdollisuuksiin arkeologisen tiedon käsittelyssä.

Lähestyn nimenomaan juuri teitä sen vuoksi, että mm. verkosta löytämäni materiaalin ja muiden ennakkotietojeni perusteella katson juuri teidän voivan antaa tutkimukseni kannalta oleellista tietoa. Haastatteluun osallistuminen ei edellytä erityisasiantuntemusta tietokoneisiin liittyen eikä edes varsinaista kiinnostusta niitä kohtaan. Olen kiinnostunut eri tyyppistä työtä tekevien tavallisten arkeologisen löytöaineiston kanssa työskentelevien tutkijoiden käsityksistä, työtavoista ja mielipiteistä.

Teen tutkimusta, jonka yksi osa nämä haastattelut ovat, Åbo Akademissa informaatiotutkimuksen oppiaineessa. Tutkimuksen tulokset on tarkoitus julkaista väitöskirjassani.

Toivon, että voisitte varata haastattelua varten aikaa kaksi ja puoli tuntia, jotta voimme keskustella rauhassa kaikista haastattelun kannalta olennaisista teemoista. Haastattelua voisi mahdollisuuksien mukaan yrittää sovittaa vielä kuluvaan kevääseen.

Vastaan mielelläni kaikkiin mahdollisiin ja mahdottomiin kysymyksiin koskien tutkimustani ja itse haastattelua. Väitöskirjatyöstäni voi tiedustella myös ohjaajaltani professori Sara von Ungern-Sternbergiltä (puh. 02-2154575, sposti sungern@abo.fi).

Toivon kovasti, että vastaatte myöntävästi, sillä asiantuntemuksenne vuoksi katson, että nimenomaisesti juuri teidän osallistumisenne olisi tutkimukseni kannalta ensiarvoisen tärkeää.

Ystävällisin terveisin,

Isto Vatanen FM,
tutkija, ma assistentti
Institution för allmän samhällsforskning
Informationsförvaltning
Åbo Akademi
puh. 02-2153467 (työ), 040-5726259 (matkapuh.)
Sposti: ivatanen@abo.fi

A.2 Swedish language version used in Sweden

Bästa mottagare,

Jag ber vänligen om att få intervjua Dig för mitt forskningsprojekt, som gäller utveckling av dokumentation samt datorbaserad hantering av arkeologiskt material och information. I forskningsprojektet skapas och testas konkreta metoder för att rent praktiskt underlätta administration av arkeologisk information och arkeologins praxis i framtiden. Syftet är att finna faktorer som behövs för att utveckla lätthanterliga och effektiva informationssystem till arkeologins och arkeologernas behov och tankesätt.

Målet med intervjun är att klarlägga arkeologers sätt att skaffa, använda och producera information samt att kartlägga attityder kring datorbaserad grafik och dess potential i behandling av arkeologisk information.

Jag skriver Dig eftersom er hjälp skulle vara speciellt värdefull för mitt projekt, enligt den information jag har fått och hittat om Din verksamhet. Att delta i intervjun kräver ingen särskild expertis i datorer eller ens speciellt intresse i datorbaserade metoder. Jag är intresserad av de arbetssätt och åsikter arkeologer inom olika arbetsfält har.

Dessa intervjuer tillhör ett forskningsprojekt som jag företar i ämnet Informationsförvaltning vid Åbo Akademi. Resultaten på forskningen skall publiceras i min doktorsavhandling.

För att vi skall kunna diskutera alla väsentliga teman i lugn och ro hoppas jag att Du kunde reservera cirka två och halv timme för intervjun. Jag planerar att göra intervjuer i Sverige redan i oktober. Vi kan diskutera en närmare tidpunkt senare.

Jag svarar gärna på frågor gällande min forskning och intervjuerna. Uppgifter om min avhandlingsprojekt fås även av min handledare professor Sara von Ungern-Sternberg (tel. +358-2-2154575, e-post sungern@abo.fi).

Ditt deltagande skulle vara speciellt viktigt för projektets genomförande och jag hoppas få ett positivt svar.

Med vänlig hälsning,

Isto Vatanen
Fil. Mag., forskare
Institution för allmän samhällsforskning
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Appendix B

Interview guide

Demographics

1. How long have you been involved with archaeology/material cultural heritage?

2. What is your educational background (i.e. in which subjects you have earned a degree)?

3. What have you studied apart from your main subject?

4. Can you describe your present work i.e. do you teach, do administrative duties, do collection management, excavate or something else? (Do you "work", "do research" or what would you like to say you do?)

5. Tell me about your work history. Have you worked before your present post on cultural heritage? If yes, where? What have you done apart from working on (material) cultural heritage/archaeology/ history/museums?

6. What do you think is best, most interesting or positively challenging in working with archaeology/material cultural heritage? (to estimate motivations, commitment and viewpoints of the interviewee)

7. What are the worst, pressing and/or the most actual problems regarding your work with archaeology/material cultural heritage?

Interaction with information

2.1. Archaeological work and information behaviour: archaeologists and the information activity

1. Could you tell about the organisation of your work with archaeological material?

2. Is it based on projects, or tasks? (Aim is to ask the interviewee describe her work and to establish a correct term to discuss on duties/projects of non-trivial scale).

3. I would like you to describe your practical work from the beginning of a {project} to the end? Is it possible to divide the work into some phases? What do you need to know in each phase, what kind of information do you seek and where?

In each phase following facets of information activity are discussed in appropriate detail: (Classification of interactions is according to Cool and Belkin [186]).

1. Communication behaviours
2. Information behaviour
3. Information objects
4. Dimensions
5. Interaction criteria

Information creation

Complementary questions (subjects) asked if not referred in the initial discussion (if applicable to the process described by the interviewee).

1. What would be the most important source of information regarding your work?
2. What you do when you are offered an excavation/survey project somewhere or are you actively looking for them? What kind of preparations do you do to acquaint yourself with the {subject} of the {research}?
3. When you have a problem, you do not recognise an artefact or a structure, what do you do (i.e. where do you seek information, do you attempt to give a half-way explanation, in which cases do you seek for expert advice, in which cases do you think you yourself are an expert)?
4. What do you do when you are assessing the general meaning of {a site you have been excavating}?

Dissemination

1. Have you created information based on archaeological material? What kind? (e.g. reports, databases, articles, books, given talks etc.) Have you produced a lot or a little? How much is that?
2. To whom have you been writing/publishing? (e.g. professionals, general public, children etc.) Tell me about writing to different audiences. What kinds of differences and similarities there are?

Complementing questions

1. If I would like to know something about a site X (of your expertise), where would you suggest me to get that information?

2. Let's imagine a situation where you yourself had no physical access to browse a collection of finds and you would have to explain someone else what you did like him or her to get you? The situation would thus be quite the same than in a library with no open shelves, and you had to describe the objects to be retrieved somehow to another person. How and by what means would you rather describe the finds you would like to inspect by hand?

Information source use and perception

Primary sources

1. Archaeological material
2. Historical accounts (textual primary sources)

Scientific secondary sources

1. Articles (electronic, printed, free articles in Internet; indicate the order of importance)
2. Monographs (series, specific publishers, specific authors, classification see above)
3. Reports (excavation, survey etc.)
4. Thesis, dissertations (unpublished, published)
5. Reference works (specialised encyclopaedias)
6. Formal(ised) datasets (collection databases, results databases, other databases, statistics etc.)

Graphic presentations

1. Maps (topographic, thematic, excavation site, profiles, classification see above)
2. Tables
3. Photos
4. Films, video (filmed on-site)

Socially acquired information

1. Conferences or colloquies
2. Public lectures, presentations
3. Informal professional occasions
4. Courses (on a theme)
5. Association memberships
6. Personal communication

7. By what means do you mostly communicate? (Orally, email, letters, by exchanging manuscripts)
8. Experts (on different special subjects within archaeology, outside archaeology)
9. Interviews or chatting with people from the area studied on course of the research (elderly people, local history enthusiasts)
10. Colleagues (peers, superiors; fellow countrymen, foreign)
11. Students (who you supervise somehow, if applicable)
12. Research assistants (working for you)
13. Friends (not colleagues)
14. Information professionals, librarians, archive professionals (do you ever use?)
15. Reflection
16. Own experience (how much you trust on your own judgement even when the situation is not precisely familiar?)

Non-scientific, popularised sources, media

1. Works of local history (semi-scholarly books, community heritage publications)
2. Newspapers (printed; on-line)
3. (Popular) magazines, journals
4. Brochures
5. (Operation) manuals
6. TV
7. Radio
8. Companies, commercial information
9. Material on the Internet (not including articles)
10. Encyclopaedias and other general references

Metasources

1. Bibliographic databases
2. Review journals/sites
3. Citation indexes
4. Announcements, news, lists on coming publications
5. Book advertisements (in different publications)
6. (Email) Alert services of publishers
7. Browsing bookshop shelves

Complementary questions

1. Other (sources mentioned by the interviewee)
2. Do you think I omitted some relevant sources or source types? What would they be?
3. General qualities of a good information source? How would you describe what would be a good secondary source like (for which purposes you would use, you have used, have you used at all)? What is essential and what do you look after to assess the quality of any given piece of material?
4. General qualities of a bad information source? How would you describe what would be a bad secondary source?

Information behaviour case study

According to the framework of Line (1969) [492] and Nicholas and Martin (1997) [550] complemented with hypothesised issues.

1. Tell me about writing this {article}? (When did you write it, what for, for whom, why) What did you exactly do? You opened a word processor and began to write, but what about before? Try to describe in wholly concrete and practical terms.
2. What was the purpose to write this {article}? Why did you write it? What did you want to tell/publish?

Characteristics of information need

1. Could you tell me, what is this {article} about? Which are the key themes of it? On which themes did you need information while writing it? (Subject)
2. To study this kind of subject, what kind of information do you need (theoretical, conceptual, historical, environmental, statistical...)? (Nature)
3. When you looked at (an information source, choose an artefact or representation of it), what did you expect to find, what were you looking after? (Function)
4. What was your view (perspective) on the subject? Were you presenting something new, contradictory, supporting existing knowledge, presenting new sources, arguing for a new interpretation? (Viewpoint)
5. Did you choose any sources because they were written by special very well known authorities of some field or was it enough to concentrate on information which seemed to be valid from your viewpoint? (Authority)
6. How much sources did you read altogether, are they all here? (Quantity)
7. Did you/How did you assess any requirements on the quality of sources, did you discard something because of poor quality? (Quality)
8. Where did you collect your sources from? Hometown, abroad, central archives etc. (Place of Origin)

9. Did you prefer some sources (e.g. Internet) because the material was readily obtainable there with no delays? (Speed of delivery)
10. Did you choose material because the book seemed to be attractive looking, it was in handy file format (e.g. PDF) etc.? (Processing/packaging)
11. Did you confine your sources because you thought you were unable to interpret some (e.g. geophysical, statistical, material, literary) data/information? (Training)
12. Did time constrains effect your selection of sources? Would you have otherwise checked another groups of materials, or included material from somewhere else? (Time)
13. How much did you have time to write the {article}, did you have enough financial resources for copying, travelling, needed software to do all the analysis you needed? (Resources)
14. Did you encounter any problems in getting a permit to inspect some source material, was some material far too distant for you to check? (Access)
15. Were there any themes on which you had too much information in hand, and you had to select just a few somehow to be able to have the work finished, not because the rest of the sources were e.g. of poor quality? (Information overflow)
16. Did you confine your sources because some of them were inappropriate to be used in archaeological {research}? (Appropriateness) What would be inappropriate?
17. Could you think of anything else important regarding the {article}, sources, and working with it?

Interaction with the past

1. What is important in an artefact (or in the material you know well e.g. architectural)?
2. What makes an artefact archaeologically interesting?
3. How would you interpret this item? What is interesting or important in it? Why did you come to that conclusion (a replica of something, better if an item, might also be an image)?
4. What is relevant to know of the past from the archaeologists point of view?
5. Why is it important to know something about the past?
6. What kind information is relevant for studying the past?
7. (Who owns the past?) For whom do you write/do your work/research the past? What is your audience? Do you feel responsibility, and if you do, for whom? Does your audience have effect on how, what and on which themes do you write?
8. How would you describe yourself as a {researcher/interpreter of the past}? What are your intentions, or do you think you have none?

Interaction with the infrastructure

Spatial ability

1. Do you think you are "spatially able"? Spatial ability is described as being "the measured aptitude for perceiving and comprehending relations involving space or extension." (OED 2nd ed. 1989)

2. Do you think you are a literal or a visual kind of person?

Computers

1. Do you use a computers while working?

2. For which purposes do you use a computers?(Writing, drawing, archiving data, seeking information...)

3. Where do you use a computers? (In office, in field (in office or outdoors), at home)

4. Do you think you can use computers? How would you describe your skills? (basic tasks, as a tool, advanced, programming or software development)

5. Name some of those computer programs and services you use most while working.

6. Name some programs or services you use hardly at all while working? (e.g. something you would expect some of your colleagues are using, or something you think might be useful) (Interviewee is expected to name some programs he/she considers interesting/essential even though he/she is not using them.)

7. Have you ever used a mapping/GIS program (MapInfo, AutoCAD, ArcView)?

8. Have you ever used a 3D modelling program (Maya, 3D Max etc)?

9. Do you think you are interested in learning and using new software and computer systems for your work?

10. How would you describe your computer you are working with?

11. Do you think archaeologists use computers a lot or a little? More or less than you do?

12. Is their any difference between some groups of archaeologists? E.g. older and younger generations, organisations (universities, museums...), research themes and subjects, other?

13. How would you describe the essentiality or unessentiality of computers in doing archaeological research?

3D computer graphics

1. How would you describe the concept “three-dimensional computer graphics”?
2. How would you describe the concept "virtual reality"?
3. How would you describe the concept "virtual environment"?
4. Have you ever played a) computer games with 3-dimensional elements b) used a VR model on a computer c) used a VR room?
5. Do you find it (if no for previous, Do you think it would be) easy or difficult to play/use 3D programs?
6. Do you think that 3D computer graphics and/or virtual realities could be used in archaeology?
7. Do you know (if) 3D graphics have been used for archaeological applications? Have you ever used or looked at these kinds of applications? What do you think about them? (Please note, that I am not expecting you to express some particular opinion, therefore try to express what do you actually think?)

Imagination exercise

Take this item (or think this building/landscape depending on the scientific interests of the interviewee) and think of a virtual reality environment. Imagine yourself into it. How would you like to be able to “make this artefact speak”.

How would you like it to reveal you something about itself. In what shape would you like to see it? (Think how a virtual reality might benefit your archaeological work - creating, recreating, manipulating, observing, watching and presenting something in three dimensions. Describe/imagine an idealistic virtual reality environment for that purpose. First try to choose a definite purpose for the system, then describe how it functions from the users’ point of view.)

Think of this building and same time continue to think the item you have in your hand. Try to augment your dream. Think that both these two elements: item and this building would be part of your virtual reality. Would they relate to each other? How would you tell me that this item was originally made over there (mention a place in the landscape)? What could you do in that environment as an archaeologist?

If you read this book, you are going to think in a book-like manner. If you set out to a virtual reality, your intellect will be affected by the information you encounter, but also by the virtual reality form and structure of the information. All the work we do comprises work with information: figuring out how to do things and what to do next. Information work benefits from using some kinds of resources and instruments, but it is also affected by the ways information is organised. Human-beings, their work, their tools of information work, the infrastructures of information and the information itself constitute the ecology of information work.

This dissertation focusses on the work archaeologists do, the information they use, how they use it and how the work is linked to the different systems of organising information and knowledge. It is the first comprehensive account of information work in archaeology and a systematic study of how the notion of virtual reality may be linked with the objectives of supporting and developing archaeological information work. This dissertation presents also a framework for integrating two focal areas of information science, the information behaviour studies and knowledge organisation, and a new approach to study and analyse human information work, called information work analysis. This study will be of interest for readers in information science, information systems development, archaeology and cultural heritage information management.

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