UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Relevance judgements in information retrieval

by

Erica Cosijn

Submitted in fulfilment of part of the requirements
for the degree of
Doctor of Information Science
In the Faculty of Engineering, Built Environment and
Information Technology
University of Pretoria

Supervisor: Prof T J D Bothma

May 2003

ACKNOWLEDGEMENTS

Many people have contributed and supported me during the years of study of which this thesis is the culmination, and I would like to thank them:

- My supervisor, Professor Theo Bothma, as well as Professors Peter Ingwersen and Kalervo Järvelin for encouragement, support and advice.

- The originators of the DISSANet programme, Professors Irene Wormell, Peter Ingwersen, Theo Bothma and Rocky Ralebipi. This three year programme to facilitate the development of IS research in South Africa was funded by Danida.

- The researchers and students at the doctoral workshops in Borås (August 2000) and Copenhagen (November 2000) for helpful discussions and advice.

- Susanna Oosthuizen and Professor Niels-Ole Pors for help on the questionnaire construction, and Rina Owen and Dr Hermi Boraine for the analysis of the empirical data.

- The volunteers who took part in the empirical study.

- My family for encouraging me and believing in me.

ABSTRACT

Recent studies in the measurement of relevance criteria across stages of document evaluation concludes that the findings "...suggest a need for continued work to map or array relevance criteria across information search process stages, variations in document representations, tasks and contexts." (Tang & Solomon, 2001).

This thesis aims to develop such a model. In this study the attributes and manifestations of relevance as defined by Saracevic (1996) are modelled in a matrix in order to define the various relevance types more clearly. From this modelling process an array of relevance types are derived, namely algorithmic or systems relevance, topical relevance, cognitive relevance, situational relevance, socio-cognitive relevance and affective relevance.

These identified relevance types are then modelled on an existing cognitive model of information transfer, as defined by Ingwersen (1996). The Ingwersen model was utilized because it explores the multifunctional and cognitive array of representations of both the information objects, and the cognitive space of the user, both as influenced by the environment. By the re-organization of this model, the different types of relevance were shown to operate in different dimensions (and over time) of the information retrieval process. This model has the added advantage that it may be possible to specify whether relevance judgments were made during the work task or the search task execution.

The viability of this model is then indicated by utilizing the published results of two empirical studies, namely that of Barry and Schamber 1998) and Vakkari and Hakala (2000). The criteria identified in this process were then consolidated, analysed and allocated to the corresponding manifestations of relevance and relevance types as identified and modelled, excluding the more "objective" relevance types, over which the user does not have much control.

The research questions posed relates to various aspects of the model, such as the relationship between affective relevance and the other subjective relevance types, the existence of socio-cognitive relevance, the relationship between cognitive and socio-cognitive relevance and the judgements of documents within work task domains. The model was then tested, both in terms of the validity of the construct and the research questions stated. The empirical testing was done by means of questionnaires, once the work task of the respondent has been completed.

The structure of the thesis is as follows: Chapter 2 is a literature review tracing the history of relevance research as well as the multidimensional and dynamic nature and the interdisciplinary research involved. Through this overview it becomes clear that there is a need to model relevance types in terms of a more holistic approach, and therefore the development of such a model has been formulated in Chapter 3. Chapter 4 describes the construction of the questionnaires in order to test the model developed in Chapter 3. The results gathered by means of the questionnaires are presented and discussed in Chapter 5. The conclusion and discussion of the results in terms of the model developed are documented in Chapter 6. Chapter 7 reviews the larger significance of the results in terms of possible practical implementation of the findings.

LIST OF FIGURES

LIST OF TABLES

"Relevance will serve its purpose, but will decline as the realization slowly comes that an individual's information need is so complex ... The gradually increasing awareness of a human's incapability of stating his true need in simple form will tend to pull the rug out from under many IR system evaluation studies which will have been done in the meanwhile." (Doyle, 1963)

"Our understanding of relevance in communication is so much better, clearer, deeper, broader than it was when information science started after the Second World War. But there is still a long, long way to go." (Saracevic, 1975)

"We consider the pursuit of a definition of relevance to be amongst the most exciting and central challenges of information science, one whose solution will carry us into the 21st century." (Schamber et al., 1990)

"Relevance is a necessary part of understanding human behaviour. The field should be encouraged by commonalities across perspectives, not discouraged by disagreements. Relevance presents a frustrating, provocative, rich, and - undeniably - relevant area of inquiry." (Schamber, 1994)

"Nobody has to explain to users of IR systems what relevance is ... People understand relevance intuitively." (Saracevic, 1996)

CHAPTER 1: INTRODUCTION

1.1. The concept of relevance within the context of Information Science

Relevance may be regarded as the central and most fundamental concept in the study of information science. Information science as a discipline evolved because of the so-called information explosion. Information is the central theme in the subject of information science, and more to the point, we are studying relevant information, not just any information. As Saracevic (1996) states: "...not only information, but information characterized by its relevance became the key notion in information science. And the key headache."

When end-users seek and retrieve information from an IR (information retrieval) system, the resultant retrieved information objects have to be judged in terms of the relevance of the documentation in relation to the users' information need. In the study field of information science, these judgements which were initially studied in order to improve the IR systems, were binary in nature – either the information object was relevant or it was not – and were made by independent assessors, based on the relation between the request and the retrieved information objects. At this time, there was no practical substitute for relevance as a concept by which to evaluate IR system performance, although it was realized that the fuzzy nature of relevance judgements made it a dubious tool to use when quantifying IR system performance.

When users interact with IR systems, relevance becomes a "psychological predicate that descries [sic] his acceptance or rejection of a relation between the meaning or content of a document and the meaning or content of a question" (Taube, 1965). Greisdorf and Spink (1999) note that "while the construct of black versus white is composed of mutually exclusive alternatives (just as relevant versus irrelevant is composed), this does not preclude the use of the construct in a relativistic manner. Thus more grayness versus less grayness as a further abstraction of the construct black versus white is equivalent to partially relevant versus partially not relevant in relation to the

construct of relevant versus irrelevant." Relevance is therefore not measured in terms of absolute judgements, but rather comparatively and holistically.

1.2. The research problem

This study has assumed that judging relevance is an evolving process that takes place during information seeking (search task) and the review of subsequent retrieved documents during the execution of the work task. There are various factors influencing this process of judging - not only internal factors (the users' understanding or cognition), but also external factors, for instance the situation giving rise to the information need and the socio-environmental context in which the work task was generated.

The concept of relevance may reasonably be viewed as a "relatedness in degrees." For a large part of research, these degrees are typified as "relevant", "partially relevant" and "not relevant". These studies look at relevance from the perspective of the reasons why users accept or reject retrieved documents. However, if these degrees of relevance can be defined as relations between information objects on the one hand and some specific part of the seeking and retrieval process on the other hand, and these *relations* are studied instead of the *reasons* for acceptance or rejection, we may come to a better understanding of the concept of relevance.

1.3. Aims, goals and research objectives - research questions

The aim of this research then has been to try to "map" relevance types in the information seeking and retrieval process. This "mapping" was done in terms of various relations between the information objects on the one hand, and specific phases of the seeking and retrieval process on the other. The assumption is made that the Ingwersen model of cognitive information transfer (Ingwersen, 1996) is a valid construct to describe the elements and processes involved during information transfer. This model forms the basis of a new relevance model, indicating the relationships involved in various relevance types.

The main research question that has been addressed can be stated as follows:

> *How useful, in terms of understanding relevance, is it to define relevance types by means of relations between elements in the process of information transfer?*

In order to answer this question, the generally accepted categorization of relevance types by Saracevic (1996) have been analysed in detail in terms of the attributes inherent in relevance judgements. Specific issues that have been addressed here are the notion of *motivational relevance*, the notion of *affective relevance* and *intention* as a relevance attribute. A modified relevance model was then constructed and tested empirically. Once this has been achieved, the following sub-questions can be answered:

1. *Is this categorization of relevances a viable way of typifying relevance types?*
2. *To what extent does the nature of the work task influence the application or non-application of documents in work task fulfilment?*
3. *Which types of relevance judgements are made during the process of seeking for information (search task) and which are made while using information (during the execution of the work task)?*
4. *To what extent are the identified relevance types "nested"? In other words, are certain relevance judgements by definition included within other types of relevance judgements?*
5. *To what extent are affective relevance judgements made in conjunction with other types of relevance judgements?*
6. *Does socio-cognitive relevance exist separately from cognitive relevance?*

1.4. Methodology

The modified relevance model has been developed by means of a literature review of the development of the concepts of relevance and information transfer. The model was then tested, both in terms of the validity of the construct and the research questions identified above. The empirical testing

was done by means of questionnaires, once the work task of the respondent has been completed. The work tasks of the respondents were research projects, and three groups were represented - undergraduate students doing class assignments, post graduate students writing masters dissertations or doctoral thesis and advanced or expert researchers writing journal articles or conference papers. The questionnaire consisted of three parts:

Section A served as a contextualisation for both the work and search task.

Section B had to be completed for each document retrieved and used to such an extent that it was included in the bibliography of the information object being created (thesis, research paper, etc.).

Section C had to be completed for every document retrieved and read, but not cited in the resultant created information object.

1.5. Outline of thesis

The structure of the thesis is as follows: Chapter 2 is a literature review tracing the history of relevance research from the first formal discussion in 1958 at the International Conference for Scientific Information (ICSI) to the (sometimes heated) debates in recent times. Looking at the historic development of the concept of relevance, the multidimensional and dynamic nature and the interdisciplinary research involved, it becomes clear that there is a need to model relevance types in terms of a more holistic approach, and therefore the development of such a model has been formulated in Chapter 3. Chapter 4 describes the construction of the questionnaires in order to test the model developed in Chapter 3. The results gathered by means of the questionnaires have been presented and discussed in Chapter 5. The conclusion and discussion of the results in terms of the model developed have been documented in Chapter 6. Chapter 7 reviews the larger significance of the results in terms of possible practical implementation of the findings.

CHAPTER 2: LITERATURE REVIEW

The aim of this chapter is to introduce the concept of relevance by firstly looking at the various definitions and conceptions of relevance, followed by an overview of the history of the study of relevance in order to track the changing focus of the subject field. The third section focuses on the dynamic nature and the multidimensionality of the concept of relevance. It is shown that many kinds of relevance have been identified, operating in various dimensions of information behaviour, and that therefore, there has to be a variety of relevance criteria to try to deal with these variables.

2.1. Introduction: demarcation of literature covered

Due to the increasing acceptance of the importance of relevance research in the field of information science, and the renewed interest in the concept in recent times, there are many review articles on the topic. In this chapter, these review articles are mainly used to sketch the background of the state of the research in this field.

The review articles were written from different perspectives - historical overviews of past research, the various disciplines in which relevance research is being done, the dynamic nature of relevance, degrees of relevance, etc. The purpose of the literature review presented here is to give an indication that research on this important topic is still very fragmented, and that there is a great need for comprehensive and holistic models by means of which to study the phenomenon.

2.2. Relevance defined

Relevance is viewed by Saracevic (1996) as the central notion within information science. Other authors in the field also underscore this point. Schamber, et al (1990) says: "Since information science first began to coalesce into a distinct discipline in the forties and early fifties, relevance has been identified as its fundamental and central concept." Froelich (1994) also

states "... the topic of relevance, [is] acknowledged as the most fundamental and much debated concern for information science ...".

An interesting fact underscored by Saracevic (1996; 1999) is that relevance did not necessarily have to be chosen as the key notion. Uncertainty (both in information theory and decision-making theory) was also one of the options that could have been studied as the basis for information retrieval (IR), but instead, uncertainty became the focus area for expert systems, and this differentiation is still the main factor that divides IR and expert systems. According to Saracevic (1999), if the pioneers had embraced uncertainty instead of relevance as a base for IR "we would have today a very different IR, and probably not as successful".

The second point to stress is that the concept of relevance is not well understood at all. It has also been stated that "... an enormous body of IS literature is based on work that uses relevance, without thoroughly understanding what it means" (Schamber et al, 1990) and "... there was little agreement as to the exact nature of relevance and even less that it could be operationalized in systems or for the evaluation of systems" (Froelich, 1994).

2.2.1. Definitions and conceptions of relevance

Relevance is defined in the major dictionaries such as the Shorter Oxford English Dictionary (1973) as "... pertaining to the matter at hand". Relevance is also understood intuitively in that people can judge relevance without the concept having to be defined for them. A wide variety of subject fields such as psychology, communication science and computer science have tried to deal with the concept of relevance (Mizzaro, 1998; Saracevic, 1996). Theoretical frameworks abound, and yet, although relevance is a concept that is intuitively understood, it is very difficult to define.

The meaning of relevance has changed significantly since Vannevar Bush published "As we may think" in 1945. He proposed a very simplistic systems

approach to bring some order to the "bewildering array of knowledge" (Bush, 1945) that suddenly flooded human understanding after WW II, and indeed, in the 1960s when relevance had become a major research topic, the systems approach was the one adhered to (Saracevic, 1975).

On the other side of the spectrum, and taking into account contributions of other subject areas on the study of relevance, Syracuse University (Schamber et al., 1990) undertook research on the matter in the 1980s. They developed a theory of relevance that was very user-oriented, and defined as a dynamic exchange of information and communication that depends on the quality of the relationship between information and the information needs of the user.

Saracevic (1999) states this dichotomy of the relevance problem succinctly when he says "at the bottom of IR research is a quest to align systems [relevance] with other types of relevance."

In accordance with the cognitive model for interactive IR as proposed by Ingwersen (1996), IR comprises three elements or role players – systems, users, and the environment. The system involves documents or information objects (which might be represented in various ways), that are then organized in a file and, through a given algorithm, are prepared for matching a query via an interface mechanism. The user typically has a problem or a work task to perform, and a derived information need which has to be apparent to a certain degree to the user. For example, it might be verbalized before it can be transformed into a query that is acceptable to the system algorithm. The socio-organizational environment provides the context or situational framework influencing the activities of the user.

In a systems approach to IR, relevance is considered to be a property of the system, whereas in user-oriented and cognitive approaches to IR, relevance has to do with the cognitive processes of the users and their changing knowledge and needs regarding information, stimulated by the context (Ingwersen & Borlund, 1996).

Relevance in IS may be viewed (broadly) as the expression of a criterion for assessing the effectiveness in retrieval of information, or of the objects' potential to convey information. This implies that users of information are also the assessors of that information, and this human involvement signifies a large degree of subjectivity when relevance is studied.

Schamber et al (1990) summarise these views on the subjectivity of relevance as follows:

> "Relevance is a multi-dimensional cognitive concept whose meaning is largely dependent on users' perceptions of information and their own information need situations;
>
> Relevance is a dynamic concept that depends on users' judgements of the quality of the relationship between information need at a certain point in time;
>
> Relevance is a complex but systematically measurable concept if approached conceptually and operationally from the user's perspective".

We therefore know from the outset that there will never be absolute criteria for measuring relevance. However, recent studies do agree on the following aspects:

- there are different classes and types of relevance, and
- there are different degrees of relevance judgements in a variety of dimensions or levels of information behaviour.

Therefore, there has to be a variety of relevance criteria. This points to the multidimensional aspect of the study of relevance. In addition, relevance judgements are seldom static – they change as cognition changes regarding the "matter at hand".

The next section will give a brief overview of the history of the study of relevance. It is clear that the definitions and conceptions of relevance have changed over time, and the purpose of looking at the historical development of the concept is to try to understand better what relevance is, and to give direction to future studies by establishing trends.

2.2.2. The history of relevance

Mizzaro (1997, 1998), in his articles documenting the history of relevance, divides the study of relevance into three periods: "Before 1958", "1959-1976" and "1977 - present". He broadly defines the elements in the study as follows:

Relevance is commonly accepted as a relation between two entities, and these two entities are elements of two groups. In the first group there are:

- *documents* (defined as the physical entity the user will obtain through the IR process),
- *surrogates* (defined as a representation of a document) and
- *information* (which the user receives when reading a document or surrogate).

In the second group there are four entities:

- *problem* (that which requires information in order to be solved),
- *information need* (defined as a representation of the problem in the mind of the user),
- *request* (representation of the information need in human language),
- *query* (representation of the information need in a language that can be understood by the system, e.g. Boolean).

Relevance can now be viewed as a relationship between any of two entities, one from each group. Every one of the abovementioned entities may be divided further into three components:

- *topic* (subject area),
- *task* (activity that will be executed when documents are retrieved), and
- *context* (other factors, excluding topic and task that will influence the information behaviour).

Mizzaro then adds another dimension, namely that of time. The information seeking situation takes place over time, and the user's cognition of his problem changes over time. An overview document that was highly relevant at the beginning of a research project, because the user did not understand

the problem, is no longer relevant at the end of the project, because the user then knows the background, and that same document is then viewed as too elementary. The same argument goes for a user whose problem has changed over a period of time.

Each relevance, as defined in terms of the elements above, may now be viewed as a point in a four-dimensional space, the values for the four dimensions being:

- surrogate, document or information;
- query, request, information need, problem;
- topic, task, context and all the combinations thereof; and
- the time instants from the arising of the problem until it is solved (Mizzaro, 1997).

In addition to these types of relevance, Mizzaro (1997) also defines *relevance judgement* as an assignment of a value of relevance by a judge at a certain point in time, and this can happen in any of the following five dimensions:

- the kind of relevance judged;
- the kind of judge (user or non-user);
- the physical entity the judge can use (document, surrogate, information) for expressing his relevance judgement;
- what the judge can use (query, request, information need, or problem) for expressing his information need; and
- the time at which the judgement is expressed.

2.2.2.1. Before 1958

Mizzaro then uses these dimensions to describe the research done in each of the three "epochs" of relevance research as defined above.

The "before 1958" period is recognized only by the lack of clearly stated definition or conceptualisations of relevance. Nowhere is it explicitly mentioned, and is only alluded to and implied. It was in the 1958 ICSI debate

that Vickery's (quoted in Mizzaro, 1997) presentations first started the new direction in the debate on relevance. The starting point here was that there is a difference between relevance to a subject and relevance to the user.

2.2.2.2. 1959 – 1976

This period of research was characterised by the definition of relevance in terms of mathematical and logical formulae. Different kinds of relevance are recognized, as well as the difference between "relevance" and "usefulness", but in general it may be said that these distinctions were neither well-founded nor well researched. Surrogates as document representatives were also a major theme in this period of research, and while no consensus was reached on the matter of whether the quality of a surrogate improves the quality of retrieval, it was agreed that the length of a surrogate does not detract from the quality thereof (Mizzaro, 1997). Studies dealing with the criteria whereby relevance is judged, with the dynamic nature of relevance and the issue of relevance judgement expression, are few and far between. It is recognized that relevance judgements depend not only on topicality, but also on other non-topical variables, and that time may play an important role in the relevance judgements.

2.2.2.3. 1977 onwards

Whereas the previous period did not, in itself, contribute to the debate to a very large extent, the authors of that period did provide the groundwork for this next era where relevance became one of the most argued issues in information science.

The most outstanding characteristic of the latest research on relevance, is the increasing number of researchers working on a more user-oriented, cognitive perspective as opposed to system-oriented approaches only.

There are attempts to measure the so-called "subjective" relevances, by eliciting criteria for measurements from users themselves. According to Mizzaro (1997) the importance of the empirical studies conducted in the 1990s is that the existence of factors beyond topicality affecting users' relevance judgements are confirmed, and these criteria are in agreement with the ones defined in the "1959-1976" period.

The third important development in the current research on relevance is the emphasis on the fact that relevance judgements are time dependent, especially due to changes in cognition during the search task. This has the effect that many researchers maintain that retrieval systems should allow for iterative and interactive searching (Mizzaro, 1997).

The most important studies on non-algorithmic relevance since the appearance of Mizzaro's two articles in 1997 and 1998 might be seen as those of Saracevic (1996), Spink & Greisdorf (1997; 2001), Spink et al. (1998), Greisdorf (2000), Tang & Solomon (2001) Vakkari & Hakala (2000) and Vakkari (2001a; 2001b). These studies also fall within the paradigm of relevance research in the "1977 onwards" era as described by Mizzaro (1997; 1998) in that they take into account the subjective nature as well as the time-dependency of relevance judgements of users.

2.3. The multidimensionality and dynamic nature of relevance

As can be seen from the aforegoing summary of the history of the subject above, there are many dimensions to the study of the concept of relevance. Furthermore, relevance is not only of a multidimensional nature, it is also interdisciplinary. This is shown in the following subsections where firstly the subject fields in which (and from where) relevance research originated are reviewed, the degrees of relevance are then addressed, and finally the dynamic nature of relevance is discussed.

2.3.1. The interdisciplinary nature of relevance

Saracevic (1996) postulates that, within information science, there are four dominant theoretical frameworks from where relevance has been studied in the past: systems, communications, situational and psychological.

In the *systems framework*, relevance becomes the problem of matching the representation of an information object to the representation of a user's information need. The user's need is first represented as a question, which is then formalized as a query and put to the system. Retrieval is thus accomplished by matching two representations - those of queries and information objects. Within this framework, relevance is considered as a property of the system (Saracevic, 1996:207). If the system can be improved, relevance will therefore improve. However, the user, his information need and his understanding of his work task, is only narrowly part of this framework. Most of the research undertaken in the 1950s and 1960s, as well as the current TREC experiments, are based on this framework (Saracevic, 1996).

The *communication framework* considers the criterion for relevance as the effectiveness of communication in terms of exchange of messages between a source and a destination. Saracevic (1975) lists subject knowledge, subject literature and systems file (including representation) as the source, and the destination's file, the user's cognitive structure and representation, use, context and values as the destination. Relevance is then defined as the relation between any of these elements.

The *situational framework* considers that the nature of relevance is characterized by situation, context, multidimensionality, time-dependence and the dynamics of the retrieval process. Relevance is viewed as "... a dynamic concept that depends on the users' judgement of the quality of the relationship between information and information need at a certain point in time" (Schamber et al, 1990). The system is not considered here at all (Saracevic, 1996).

Within the *psychological framework* it is suggested that the users' cognitive state and processes, and the associated changes when dealing with information should be the base for studying relevance. Harter (1992) called this "psychological relevance" and it was later also referred to as "cognitive relevance". This type of relevance judgement is constantly in flux as the cognition of the user changes during the information seeking process.

All of these frameworks have their shortcomings: the systems view does not take the user into account, the communications view does not take the interactive dynamics of relevance into account, the situational framework does not take the systems into account and the psychological view made no effort to connect to IR (Saracevic, 1996).

After analysing these four major frameworks, Saracevic (1996) introduces a fifth framework, which he calls the *interaction framework*. He attempts to take into account the interactivity of IR systems and to optimise the strengths and minimize the weaknesses of the other four frameworks in order to create a framework for considering the nature of relevance in IR. The process that was followed in the establishment of this framework includes the identification of various manifestations and attributes of relevance. It was the development of this framework that gave rise to this thesis, and the implications of the identification of the attributes and manifestations of relevance have been discussed in detail in the next chapter.

2.3.2. Degrees of relevance

It has long since been known that relevance is not a simple binary judgement of being either relevant or not relevant. Bar-Hillel already states in 1958 that degrees of relevance must be considered in defining a weaker notion of relatedness in terms of documents, queries and index terms. Wilson (1973) also states that it is desirable to recognize degrees of relevance, although he did not make any suggestions as to how the degrees should be defined. Bookstein (1983) thought that partial relevance could be either a reflection of

the information object's degree of relevance, or of the uncertainty the user is experiencing regarding the relevance of the information object. Lancaster (1968) defined the middle region of partially relevant as any document considered only somewhat, or in some part, related to the question or to any part of the question. Spink and Greisdorf (1997) indicated that novelty might be a factor when users judge an item as partially relevant. It is often the partially relevant texts, and not completely relevant texts, that lead the user to search for more information because they learnt something new from the document. Spink et al. (1999) also identifies 15 criteria used to determine partial relevance, including timeliness, too technical, too narrow, insufficient information and duplicate information.

The issue of measuring degrees of relevance is very complex, and most researchers tend to group "partially relevant" together with "highly relevant" into one category of "relevant" for pragmatic reasons. A workable unifying framework is yet to be developed (Greisdorf, 2000; Maglaughlin & Sonnenwald, 2002).

2.3.3. The dynamic nature of relevance

The dynamic nature of relevance refers to the changes in the user's perception of relevance over time. Recent empirical evidence of this aspect of relevance judgement has been supplied by studies such as those of Spink et al. (1998), Tang and Solomon (1998), Vakkari and Hakala (2000) and Vakkari (2001a; 2001b). We also note that Harter's (1992) idea of *psychological relevance* is grounded by this change in the cognition of the user over time. Another dimension of the dynamic nature of relevance can be seen in the study by Robins (1997) which focuses on the dynamic nature of the interaction between the intermediary and the user. Spink et al. (1998) found that partially relevant documents contribute to the change in cognition to a larger extent than do highly relevant documents.

2.4. Research with implications for relevance

There are many research projects which deal with the improvement of systems and optimisation of information retrieval results. These projects do not necessarily have as focus the improvement of relevance judgements, but they have, nevertheless, implications for relevance research. Some of these projects have are mentioned here, but their significance for relevance research have been discussed in detail in Chapter 7.

Some of the researchers working on improvement of IR systems since 1997 are Tomaiuolo and Packer (1998), Sanderson (2000), Voorhees (1998; 1999; 2001), Lee (1998) Lam-Adesina and Jones (2001), Järvelin and Kekäläinen (2000), and Spink and Greisdorf (2001).

Some studies since 1995 with implications for non-systems relevance research are:
Ford (1999), Park (1995), Choi and Rasmussen (2001), Toms (1998; 2000), Figueiredo and Campos (2001), Fine and Deegan (1996), Spink and Greisdorf (1997), Quiroga and Mostafa (2001) and Yuan and Meadow (1999).

2.5. Summary of main conclusions based on literature review

Greisdorf (2000) notes that from the interdisciplinary publications regarding relevance, three key points emerge:

- "Relevance is a relation between an assumption and a context;
- Relevance is a matter of degree;
- Relevance can be represented in terms of comparative judgements and gross absolute judgements."

From the discussions in this chapter, it is clear the concept of relevance has changed substantially over the years and that it is now realized that relevance implies a relation, has many dimensions, various manifestations, can either be judged in absolute or relative terms, is dynamic, and is very difficult to define.

In a recent study Tang and Solomon (2001) compared experimental and naturalistic studies to measure relevance criteria across stages of document evaluation. Their conclusion was that "the findings of both studies suggest a need for continued work to map or array relevance criteria across information search process stages, variations in document representations, tasks and contexts."

The statement by Tang and Solomon (2001) above may be regarded as the rationale for this study. If we can manage to understand the way in which relevance is judged, we can improve representation of, and access to, information. IR has to be viewed as a holistic process involving systems, as well as users, within a particular context. This thesis is an attempt to develop a model in which some of the aspects of relevance may be holistically modelled within a framework of interactive IR.

In the next chapter a model is developed describing various types (or manifestations) of relevance in terms of the relations between the various elements and stages of the information seeking and use process.

CHAPTER 3: DEVELOPING A THEORETICAL FRAMEWORK

In this chapter, attributes and manifestations of relevance as defined by Saracevic (1996) and mentioned in Section 2.3.1 have been plotted against each other in a matrix in order to show that relevance functions in different dimensions for the various manifestations of relevance. The analyses reveal the necessity for a revised model of relevance types. It is argued that the manifestation of motivational or affective relevance should not be viewed as a discrete category or as part of a linear scale of relevances. Instead, motivational relevance may essentially be included in the attribute of intention, and affective relevance acts as a different dimension altogether, influencing all the other subjective relevance types. The modified model includes a socio-cognitive type of relevance that is highly context dependent and associated with either organisational strategies or within scientific community interaction.

This revised model of attributes and manifestations of relevance has then been modelled on an existing cognitive model of information transfer (Figure 3.2), (Ingwersen, 1996). The new derived model allows the mapping of relevance assessments and stresses the distinction between the use of information in work task performance and in search task activities. It is shown that relevance signifies two processes: feedback from systems (e.g. ranked output) to system, users or context, as well as the reverse process of relevance feedback from the system, users or context to the information objects. This notion of feedback from systems has already been described by Ingwersen (1984) in relation to frequency ranked terms or keyword lists applied for online query modification. It is also suggested that relevance types may be important in different ways for the search task and for the work task. Most of the work in this chapter has been reported in Cosijn and Ingwersen (2000) and Cosijn (2003).

The structure of this chapter is as follows: The first two sections present an introduction to the nature of relevance by describing different aspects of the attributes and manifestations of relevance. The third section describes a

matrix where the attributes of relevance have been plotted against the manifestations of relevance (Table 3.3). This section also includes a discussion on the emerging patterns in the matrix, by examining each of the attributes of relevance in turn. Section 3.4 contains the explanation of the modified relevance model (Table 3.4) as derived from the previous discussions. The consequences of relevance variety, and the manifestations of relevance (relevance types) are discussed in detail in Sections 3.5 and 3.6 respectively. Section 3.7 discusses the proposed consolidated model of relevance types and the modelling of relevance types on Ingwersen's Cognitive Model of Information Transfer (Figure 3.2). By re-organizing this model, the different types of relevance have been shown to operate in different dimensions (and over time) of the information retrieval process. In Section 3.8 the issues of work task and search task execution as related to the proposed model have been discussed. In Section 3.9 a discussion of previous empirical studies on relevance has been presented. The summarizing and consolidation of these empirical studies on the relevance judgments of actual users, has shown that the model described in Section 3.4 is a viable model to utilize in empirical testing of relevance judgments by users. Some conclusions and future research related to these issues are listed in Section 3.10.

3.1. Attributes of relevance

In his article of 1996, Saracevic sources from intuition, philosophy and communication, and ascribes the following attributes to relevance, starting from the assumption that relevance is rooted in human cognition, as described in Table 3.1.

Table 3.1. Attributes of Relevance (based on Saracevic, 1996)

Attributes of Relevance	
Relation	Relevance always implies a relation, often in communication or exchange.
Intention	The relation in expression of relevance involves intentions such as objectives, roles, expectations (motivation).
Context	Intention always comes from a context, and is always directed toward that context.
Inference	Assessment (often graduated) of the effectiveness of a given relation.
Interaction	Inference is accomplished as a dynamic process of interaction, and interpretations of the other attributes change as cognition changes.

This is succinctly summarized by the following statement: "As a cognitive notion, relevance involves an interactive, dynamic establishment of a relation by inference, with intentions toward a context" (Saracevic, 1996: 206).

3.2. Manifestations of relevance

Looking at the attributes of relevance as listed above, it is clear that relevance always indicates a relation. Different manifestations of relevance indicate different relations. It would therefore seem that the trend moves toward viewing relevance in IR not as a single definition of relevance, but as a system of relevances (note the plural). Consequently no single relevance in the system can be viewed in isolation. Relevance exists as an interacting system of relevances on different levels.

As with studies on the nature of relevance, manifestation studies are also widely divergent. In his article, Saracevic (1996) summarizes these studies and distinguishes the following manifestations of relevance, as represented in Table 3.2.[1]

---

[1] In all instances the term ***text*** (or information object) is seen to mean not only retrieved texts, but also texts in the system file or even texts which are in existence somewhere, but not necessarily in the system file (Saracevic, 1996).

Table 3.2: Manifestations of Relevance (based on Saracevic, 1996)

Manifestations of Relevance		
Relevance	**Describes a *relation* between:**	**Criterion for "success"**
System / Algorithmic Relevance	Query *and* information objects (texts)	Comparative effectiveness in inferring relevance
Topical / Subject Relevance	Subject or topic expressed in a query *and* subject or topic covered by information objects	Aboutness
Cognitive Relevance / Pertinence	State of knowledge and cognitive information need of the users *and* information objects	Cognitive correspondence, informativeness, novelty, information quality
Situational Relevance / Utility	Situation, task or problem at hand *and* information objects	Usefulness in decision-making, appropriateness of information in problem resolution, reduction of uncertainty
Motivational / Affective Relevance	Intents, goals and motivations of the user *and* information objects	Satisfaction, success, accomplishment

Although Saracevic does not explicitly mention it, it is interesting to note that the relevances are moving (in the order listed above) from a systems approach to a user- and socially-orientated approach. Thus the whole spectrum is included.

The view that relevance is no longer simply a binary assessment between objective and subjective relevance or consisting of a binary scale, is also supported by other researchers (Greisdorf & Spink, 1999). Borlund and Ingwersen (1998) introduce the concept of relative relevance that describes the degree of agreement between various types of relevance applied in the evaluation of information retrieval systems.

The multidimensional nature of relevance was of importance in the next step of the modelling process, where the attributes of relevance have been plotted against the manifestations of relevance in a matrix format. Each of the manifestations defined by Saracevic was compared to each of the attributes

defined to establish the connections and need for each of the attributes to be present in each manifestation.

3.3. Attributes and manifestations of relevance: What are the connections?

In this section, the manifestations of relevance have been plotted against the attributes of relevance (both as defined by Saracevic), and then the content of each of the cells in the matrix has been discussed in some detail, according to the attributes of relevance. The last column in the table is shaded, as the inclusion of these types of relevance is in question. These aspects have been discussed in Section 3.3.6 of this chapter.

Table 3.3: Attributes and Manifestations of Relevance

Relevance Attributes	Manifestations of Relevance				
	System / Algorithmic	**Topical / Subject**	**Cognitive / Pertinence**	**Situational / Utility**	**Motivational/ Affective**
Relation (See also Table 3.2)	Query to information objects	Subject/topic expressed in request to subject/topic covered by information objects	State of knowledge/cognitive information need to information objects as perceived	Situation, task or problem at hand to information objects as perceived	Intents, goals, motivation of user to information objects as perceived
Intention	a) System dependent b) Intent behind algorithm	a) User /assessor expectations b) Intent behind request	Highly personal and subjective, related to information need	Highly personal and subjective, related to work task	Highly personal, subjective or even emotional
Context	Tuning search engine performance (e.g. TREC)	All types of subjective relevances are, context-dependent			by definition
Inference	Weighting and ranking functions	Interpretation	Subjective and individualized process of selection and filtering	User's ability information meaningful	to utilize objects in a way
Interaction	Automatic relevance feedback or query modification	Relevance judgements are time dependent	Time dependent to a very large extent	Including interaction with socio-organizational domain	Highly individualized

The significance of each cell in relation to the attributes of relevance is as follows:

3.3.1. Relation

Relevance always implies a *relation*. In Saracevic's scheme, this relation is between some entity and the information object, which is simply defined as "texts" (1996: 214). We should like to argue that information objects should be defined much broader to include anything conveying information, including, for example, images. The implications of this broader definition will be discussed in more detail under 3.3.5, where the time dimension has a certain impact on the interaction process. As indicated in Table 3.3, it is clear that the relevance attribute *relation* moves from being purely objective (between the query and the system) to a highly subjective and individualized relation that involves the user's intents, goals and motivations. The detail of each of these relations is as follows:

The relation defining *system or algorithmic relevance* may be measured in terms of the comparative effectiveness of inferring relevance. This relation is very much system-orientated because the success of the relation is entirely dependent on a given procedure or algorithm, and the intent behind it. Both the query and the objects contain identical/similar features, such as terms, image colour or author name.

Topical or subject relevance is characterized by a relation between the topic of the request and the topic of the information objects. It may be measured in terms of the aboutness of the information objects. This relation is system-orientated to a large extent because the success of the relation depends on the system's indexing and searching ability to retrieve relevant objects. However, success also depends on the formulation of the request by the user, transformed into a query by the system. The assumption is thus that both requests/queries and objects may be identified as being about the same or similar topic(s).

Cognitive relevance or pertinence is described by a relation between the state of knowledge or the cognitive information need of the user and the information objects. Cognitive correspondence, informativeness, novelty, information quality, and the like are the criteria by which cognitive relevance is inferred. This relation encompasses both system and user, because the success of the relation depends on the system's indexing and searching ability to retrieve relevant information objects. However, success also depends on the formulation of the request (query) by the user. In this case, the user's ability to formulate a request is dependent on his IR and conceptual knowledge background and his understanding or perception of his information need (Ingwersen, 1992). The cognitive relevance seems to be moving towards a user-orientated relevance and away from a system-orientated relevance.

This type of relevance was also described extensively by Barry (1994) when a study was undertaken to define the criteria mentioned by users' evaluation of the information within documents as it related to the users' information-need situations. The results showed that the criteria employed by the users included tangible (form or feature) characteristics of documents, as well as subjective qualities together with affective and situational factors.

Situational relevance or utility is the relation between the *perceived* situation, task or problem at hand and the information objects as perceived. Usefulness in decision-making, appropriateness of information in problem solving, and reducing uncertainty are criteria by which situational relevance is inferred. This relation encompasses both system and user, because the success of the relation depends on the system's indexing and searching ability to retrieve relevant texts. However, it also depends largely on the user's ability to use the information objects for a certain purpose within a given situation or context. The utility relevance seems to be moving towards the interaction between the environment or domain (the situation) and the individual actor. An example could be that the actor or user takes part in a peer reviewing process in which he assesses the usefulness and impact of applicants´ works concerning a faculty position. To assess the appropriateness of the contributions, the actor is influenced by the community culture and domain.

Covering the same areas of relevance as the manifestations of topical, cognitive and situational relevance as defined by Saracevic, a comprehensive relevance model was also proposed by Mizzaro (1997; 1998). He defines relevance as a four-dimensional relationship between an *information resource* (surrogate, document, information) and a *representation of the user's problem* (query, request, real information need and perceived information need). This is then judged according to one or more of the following *components*: topic, task or context, at a particular *point in time*. For more detail on Mizzaro's model, see Chapter 2. The three components of topic, task and context have subsequently been used by Reid (1999) to define an "ultimate task relevance", to which should be added "information value" in order to include the broader social context of a task-orientated paradigm. This definition of task relevance may, however, be seen as too limiting, as it only accounts for the *search task* performer's point of view (Reid, 1999) and not to the *work task* of the end-user.

Following Saracevic (1996), the relation describing *motivational or affective relevance* is the relation between the intents, goals and motivations of the user and the information objects as perceived. Satisfaction, success, accomplishment and the like are the criteria by which affective relevance is inferred.

This relation encompasses both system and user, because the success of the relation depends on the system's indexing ability and the ability to retrieve relevant texts. However, success mostly depends on the *manner* in which the user *applies* the information retrieved. In the case of motivational relevance especially, it is the user (or group of actors) who is directly responsible for the utilization. Furthermore, the broader community in which the user operates is also involved in the measurement of the success of the relation. More than any other manifestation of relevance, Saracevic's *motivational relevance* is human- and socially-orientated as opposed to system-orientated. In accordance with Searle´s generalized conceptualisation of *intentionality* (1984) the motivational manifestation can more clearly be seen as the same

as Saracevic's *attribute of intent*. This issue has been discussed in more detail in Section 3.3.6.

One might thus suggest that the concept of motivational relevance should be replaced by the notion of *socio-cognitive relevance*, owing to the latter's social and cultural properties. The final result of a peer-review process, for instance, in the form of the final ranking of information objects submitted to a conference or candidates agreed upon by all the reviewers and its underlying reasons, are example of this type of relevance (Cosijn & Ingwersen, 2000). Another is the distribution of citations on a reference list in an essay. The *time issue* plays a crucial role in this relevance category, as demonstrated in longitudinal information-seeking studies by Wang (1997) and Vakkari (2001a; 2001b). It is interesting to note that some aspects of socio-cognitive relevance are tangible, like the overlap between objects judged useful by the actor *and* also cited in a later paper. Other aspects are not tangible and are inherent to the actor himself.

In addition, one may argue that *affective relevance*, in particular, may play a crucial role connected to the *relation* attribute in *all* the subjective types of relevances. For instance, success and satisfaction are dimensions of relevance that are usually associated with topical relevance or pertinence (Barry, 1994).

3.3.2. Intention

Saracevic defines intention as follows: "The relation in expression of relevance involves intention(s) - objectives, roles, expectations. *Motivation* is involved" (1996). These intentions are always derived from a context and are directed toward that context (see Section 3.3.3 below). For each of the manifestations of relevance, the intention attribute has been discussed in more detail.

Algorithmic relevance is very much system dependent, and if the relation is described as that between query and the information object, then intention is *not* relevant. One could make a case, however, that the intent *behind* the algorithm might be regarded as an intent towards an objective, in which case the attribute of intention is relevant in system relevance.

In *topical relevance* the relation is between the topic of the request and the topic of the text, which makes intention an important attribute of subject relevance. The objectives, roles and expectations of the user as well as the motivation behind the request (intention) will determine the relevance of the texts to the user. An interesting distinction is that drawn between the intentions (or lack thereof) of users and those of assessors. Users have intentions, but assessors (for example, in TREC experiments) possess different intentions and will therefore judge objects differently from actual users and among themselves (Voorhees, 1998).

Intention in *cognitive* and *situational relevance* is highly personal and subjective. It is very strongly related to the information need in cognitive relevance, and to the work task of the user in situational relevance. Assessors (and other non-users) are therefore excluded from the latter type of relevance because the utility value of information objects is largely determined by the intentions and motivations, such as the objectives, roles and expectations, of the actual user.

Intention in *socio-cognitive relevance* is determined by the individuals under influence of their previous experiences in context of the environment that, over *time*, influence the relevance assessments.

When one compares the *intention attribute* for the subjective relevances with the original manifestation of *motivational relevance,* it is clear that they are very similar. One may therefore argue that the rationale behind motivational relevance is, in fact, already included in the intention attribute of relevance, and that motivational relevance is not the same as affective relevance. However, affective relevance could be seen as an aspect of the intent

attribute in all the manifestations of relevance, namely as the *degree of success* or satisfaction in relation to the actor's expectations. This issue will be discussed in more detail in Section 3.3.6.

3.3.3. Context

"The intention in expression of relevance always comes from a context and is directed toward that context – the matter at hand. Relevance cannot be considered without a context" (Saracevic, 1996: 206).

For *system relevance* one may argue as follows: If intention is not relevant, context is not relevant, since intention is always derived from a context. Neither the system nor its algorithms are relevant to the context from which the user directs his query. On the other hand, if one looks at system relevance from the point of view that there may be an intent behind the algorithm, then experiments conducted in TREC, where search-engine performance is tuned within a context, context may be seen as a relevant attribute.

For *topical, cognitive, situational* and *socio-cognitive relevance* one might state that all types of subjective relevances are, by definition, context dependent. Situational and socio-cognitive relevance may be seen as the relevance types that depend the most on the context within which the user operates, that is, the given task or problem situation stimulated by the environment.

3.3.4. Inference

Inference is defined as follows: "Relevance involves assessment about a relation, frequently a graduated assessment of the effectiveness or degree of maximization of a given relation, such as assessment of some information sought for an intention geared toward a context" (Saracevic, 1996: 206).

If inference is the assessment of the effectiveness of the relation between the query and the texts, inference is relevant even in *system relevance*. Typical examples would be weighting options and ranking functions in full text search engines, based purely on execution of algorithms based on the user's query.

If inference is seen as the assessment of the effectiveness of the relation between the topic of the request and the topic of the information objects, inference must be relevant *in topical relevance* as well as in *cognitive relevance*. This would seem to be a subjective selection and filtering process between the aboutness of texts and the "matter at hand" with which the user is dealing. For cognitive relevance, inference can be defined as *interpretation* of the information object by the user, and the interaction (refer to Section 3.3.5) plays a major role in the establishment of the effectiveness of this relation.

Inference in *situational* and *socio-cognitive relevance* could be described as the user's ability to utilize objects in a meaningful way (meaningful to the user and/or the environment). Inference in this case is the assessment of the effectiveness of the relation between the user's perceived situation, task or problem at hand, and the information objects as perceived. The perception includes the cognitive influence of the context and the situation.

3.3.5. Interaction

Interaction is the dynamic process where interpretations of the other four attributes of relation, intention, context and inference of the relation towards the information objects may change as cognition changes (Saracevic, 1996: 206).

In general one could say that for *system relevance* there is no process of interaction possible between the query and the text through the system or its algorithms. Interaction is therefore irrelevant. On the other hand, in the case of Human-Computer Interaction, the user's role is solely to provide the input

(query versions), and it is possible to look at automatic relevance feedback or query modification as a type of system interaction.

For *topical relevance*, although the aboutness of the texts is a stable and unchanging factor, the interpretation, information value and therefore the relevance may change during this process. If we look again at the distinction between actual users and assessors (see Section 3.3.2), it is clear that for assessors, topicality is assumed to be stable. These, and other non-users, do not have a real work task, and therefore no motivations or expectations according to which the real information value or relevance to the information need can be assessed.

Regarding the aboutness or topicality of texts, it should be noted that the time dimension is stable, and thus has little influence on *system* and *topical relevance*. However, for *cognitive, situational* and *affective relevance* changes in cognition over time have a large influence on the dynamic process of interpretation, and are particularly individualized in *affective relevance*.

Cognitive relevance is characterized by the novelty, informativeness, information quality, and so forth, that depend on the user's need at a particular point in *time*. In turn, the user's need changes as his understanding and state of knowledge (cognition) on the subject change during a session.

Interaction in *situational relevance* is the extent to which the user utilizes the text to his specific purpose in a given situation is subjective, and is very individual. The relevance of interaction as an attribute within the manifestation of situational relevance, is therefore very clear. Implicitly, previous or simultaneous interaction with the socio-organizational domain may influence the inference owing to its contextual power.

To a large extent, this is also in agreement with the following two points summarized by Reid (1999), namely that if a user has only topical criteria for relevance assessment, his ideas of relevance are not likely to change substantially over the course of a session, while in a task context these ideas

are likely to change more radically as the user's focus moves from the concerns of the IR session to the consideration of which information is required to complete his work task. Furthermore, "the post-session task context and broader social context will heavily influence the user's ideas of relevance, so his ideas will continue to be modified after finishing the IR session and even after completing the task" (Reid, 1999).

In Section 3.2 it was argued that a broader definition of information objects than merely "texts" is essential. If one should consider other information objects (such as images), it is quite clear that the degree of semantic openness is much greater than that of texts. Therefore, if this definition is broadened, the interaction (especially in the more subjective relevances) may change quite dramatically.

3.3.6. Motivational relevance as intentionality

Affective or motivational relevance is defined as the "relation between the intents, goals, and motivations of a user, and text retrieved by a system ... Satisfaction, success, accomplishment and the like are criteria for inferring motivational relevance" (Saracevic, 1996: 214). In Section 3.3.1 it was argued that *affective relevance* is not the same as *motivational relevance*, and that the latter concept is already included in the *intention attribute* of relevance.

Information could partly be viewed as something which, "when perceived, affects and transforms the recipient's state of knowledge" (Ingwersen, 1992). *Perception*, in turn, relates to *intentionality*, defined by Searle (1984) as "that feature of certain mental states and events that consists in their ... being *directed at*, being *about*, being *of*, or *representing* certain other entities and states of affairs".

Searle (1984) argues that teleological forms of explanation are those in which a phenomenon is explained in terms of goals, aims, purposes, intentions and

similar phenomena. Furthermore, all teleological explanations are merely species of explanation in terms of intentional causation. The latter may be further described by means of *intrinsic intentional phenomena,* which are those beliefs and visual experiences (states and events) that really exist in the minds of the agents and are to be taken literally. Further to this there may be a *derived intentionality,* namely a more specific level of intentionality derived from intrinsic intentionality. This is in agreement with Saracevic's definition of the intent attribute of relevance.

As motivational relevance also deals with the intents, goals and motivations of the user, it can be argued that motivational relevance might be redundant if defined as a relevance type, as all the elements thereof are already included in the intent attribute.

Affective relevance, under various labels, has been studied in the literature for quite some time (Schamber, 1994) and it is clear that it is an important manifestation of relevance. It is not clear, however, why this type of relevance should be classed as a separate category, or as the ultimate subjective relevance on a scale of relevance. Judging from current literature it seems that the level of influence of affective relevance differs from those of the other subjective relevance types. It may therefore be argued that affective relevance acts rather as another dimension, influencing all the previous subjective relevance types.

3.4. The modified relevance model

The revised model of attributes and manifestations of relevance is shown in Table 3.4. From an IR evaluation perspective the algorithmic and topical relevance types have been applied mainly to the non-Boolean (best match) experiments whilst topicality and pertinence are predominant in interactive investigations based on Boolean systems. It is only recently that situational relevance has become an issue in information retrieval, also in connection with interactive best match systems evaluation (Borlund & Ingwersen, 1998;

Borlund, 2000). Similarly, graduated relevance assessments are still rarely used in interactive IR experiments (Spink et al., 1998).

Table 3.4. Revised table of relevance types and attributes

	Manifestations of Relevance				
Attributes of Relevance		⇔ **Affective Relevance** ⇔			
	Algorithmic	**Topical**	**Cognitive / Pertinence**	**Situational / Utility**	**Socio-Cognitive**
Relation (See also Table 3.2)	Query ⇒ Information objects (feature-based)	Subject/topic expressed in request ⇒ information objects as perceived	State of knowledge/ cognitive information need ⇒ Information objects as perceived	Situation, work task or problem at hand as perceived ⇒ Information objects as perceived	Situation, task or problem at hand as perceived in socio-cultural context ⇒ Information objects as perceived
Intention	(a)System dependent (b)Intent/ motivation behind algorithm	(a)User /assessor expectations (b)Intent/ motivation behind request	Highly personal and subjective, related to information need, intentions and motivations	Highly personal and subjective or even emotional. Related to goals, intentions and motivations	Personal, subjective / org. strategy. Related to user's experience, traditions, scientific paradigms
Context	Tuning search engine performance (e.g. TREC)	All types of subjective relevance are, by definition, context dependent (user's / assessor's context)			
Inference	Weighting and ranking functions	Interpreta-tion of aboutness and subject matter at semantic level	Subjective and individualised process of cognitive/ pragmatic interpretation, selection and filtering	User's ability to utilize information objects in a meaningful way to user	Users' (or group's) ability to utilise information objects, meaningful to environment
Interaction	Automatic relevance feedback or query modi-fication	Relevance judgements are content dependent	Relevance judgements are content, feature, form & presentation dependent	Including interaction *with* environment	Including interaction *within* environment
		Increasing Time Dependence ⇒			

In table 3.4 *affective relevance* has not been placed as a manifestation or as an attribute of relevance, but rather as a dimension in line with time. The latter dimension poses an increasing impact during interaction on the relevance assessments.

Socio-cognitive relevance is regarded as a subjective type of relevance determined by the individual actor in *interaction* with other actors *within a community*. When tangible and measured, it often exhibits statistically objective characteristics (inter-subjectivity) and this is the reason for its application in mapping scientific fields that are reliable, but which has a degree of uncertainty. This is also the reason for its obvious link to system-input relevance (not dealt with in this thesis). The absolute distinction between a relevance type and its degree of measurability needs to be considered. If something is tangible it might mean that there is a convenient *operational variable* – for example citations or accepted papers - but the complete association to the underlying *theoretical variable*(s) may not really be known. For instance, it may be quite difficult to distinguish experimentally between pertinence and situational relevance: are users capable of distinguishing between the situation causing an information need which, as a knowledge gap, is difficult to express and that information need itself? One possible way of measuring pertinence might be to assess the *learning effect* obtained during a search session, for instance, by observing the semantic changes that take place as the search progresses. This has been done experimentally by Ingwersen (1982) and Chen and Dahr (1990).

Situational relevance is different from the socio-cognitive type in that it is purely subjective. The differences arise particularly in relation to the intention, inference, and interaction attributes. The interesting tangible difference lies exactly in the difference between, for instance, *single reference lists* (individual recognition of use and interpretation) in scientific papers representing a particular research situation in time, and many such lists broken down into single *citations received by* individual authors, articles, journals, institutions or countries. Analyses of citing publications, represented

by their cited works, and cited objects, represented by the citing publications, imply individual or domain-related cognitive authority, signifying situational and socio-cognitive relevance respectively. One might hence argue that if a journal impact factor (JIF) is divided into journal self citation and external citation impact figures (Christensen et al., 1997), the latter ratio actually represents an estimate of the socio-cognitive relevance of that journal. Socio-cognitive relevance can thus be regarded as a domain-dependent and quality-associated measure, also of the relevance of Internet objects through the link structure to a domain. Other kinds of citation analyses may signify different facets of this manifestation of relevance. It may be observed how socio-cognitive relevance establishes an obvious bridge between information retrieval and scientometrics.

3.5. Some consequences of relevance variety

Voorhees (1998) demonstrated that statistically there is no difference in the *relative performance* rankings between the systems involved in TREC if, for instance, three assessors versus one are making topicality judgements of retrieved documents, provided that enough queries (> 40) are run against the systems. The explicit conclusion is obviously that there is no need for several assessors in non-interactive IR experiments – one is enough provided a sufficient number of queries are applied. From a broader perspective this is a promising result as it demonstrates that, even in completely unrealistic but stable retrieval environments (non-interactive TREC), inter-assessor inconsistency is significant for some individual queries. From a cognitive and performance point of view such queries should be interesting to analyze further.

Secondly, Voorhees' exercise indicates that in realistic, i.e. interactive, IR experiments one assessor is as good as anybody else, including users as assessors. One might hence apply the classic placebo-like experimental setting with two groups of simulated work tasks to be performed by two groups of test persons confronted with one machine, or applying other

combinations of test groups, query/need/work task/situation types, and systems to be compared (Pors, 2000).

It is thus realistically possible directly to apply and *compare* the variety of relevance types depicted in Table 3.4, for instance, as done empirically in relation to algorithmic, topical and situational relevance by means of the relative relevance (RR) measure studied by Borlund and Ingwersen (1998). The relevance scheme can be seen as a tool for characterizing more profoundly the individual systems which, in turn, may inform about what to alter in the systems and why.

By plotting the attributes of relevance against the manifestations of relevance, it can be shown that the *attributes* of relevance function in different dimensions for the various *manifestations* of relevance. It is argued that the manifestation of *motivational/affective relevance* should not be viewed as a discrete category or as part of a linear scale of relevances. Instead, motivational relevance may essentially be included in the attribute of intention, and affective relevance acts as a different dimension altogether, influencing all the other subjective relevance types. Some empirical investigations clearly demonstrate this phenomenon. The analyses revealed the necessity for revising the model of relevance types. The modified table includes a *socio-cognitive* type of relevance that is highly context dependent and associated with organizational strategies or scientific community interaction within.

3.6. Relevance types

The matrix as described above is used as a framework for defining relevance types, each of which is discussed in detail below. These identified relevance types have then been modelled on an existing cognitive model of information transfer, as defined by Ingwersen (1996), and as indicated in Figure 3.2 in the next section.

3.6.1. Algorithmic relevance

System or algorithmic relevance is measured in terms of the comparative effectiveness of logical or statistical similarity of features inferring relevance. This relation is system-oriented to a very large extent, as it depends on the degree of similarity between the features of the query and the features of the information object. This type of relevance is by nature system-dependent. It is not influenced by the user, nor is it related to any subjective information need the user may have.

Retrieval performance may be improved through improving retrieval engines and performance may then be measured in terms of assessments. A typical classification of the various techniques used in retrieval systems is given in Figure 3.1.

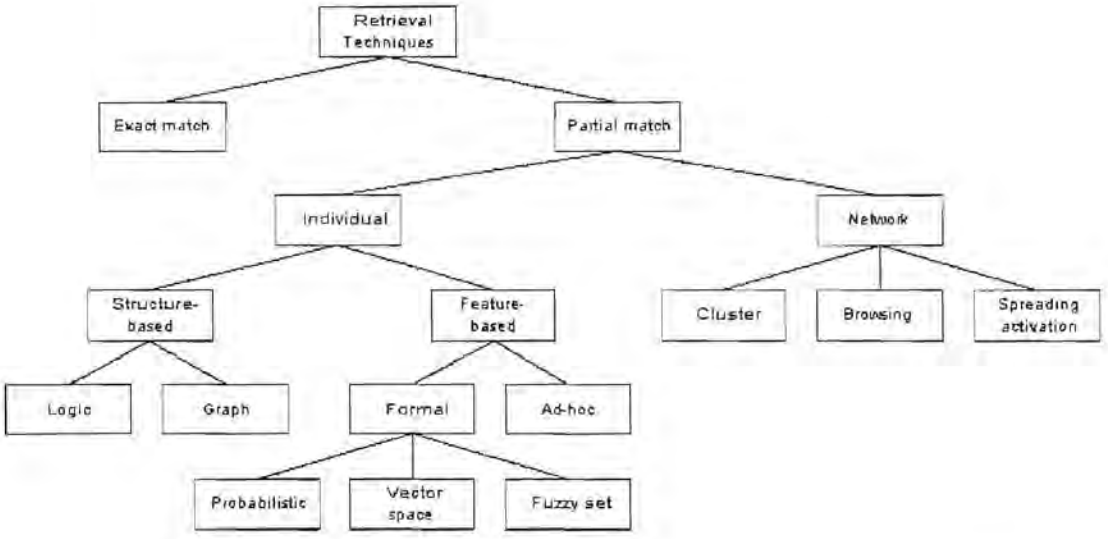

Figure 3.1. A classification of matching methods (redrawn from Belkin & Croft, 1987)

When the techniques for comparing the query with the document representations are optimised, in any of the methodologies listed above, relevance is optimised.

3.6.2. Topicality

Topical relevance is the relation between the topic of the request and the topic of the assessed information objects as perceived, and may be measured in terms of the aboutness of the information objects. The finding of focus during the formulation of the request by the user, which is then transformed into a query by the system, is the determining factor in the success of this relation.

The assumption is that both query and the objects may be assessed by a cognitive agent as being about the same or a similar topic, which implies a degree of subjectivity on the user side. The subjectivity is compounded if the information objects are represented by human-indexed terms.

3.6.3. Cognitive relevance or pertinence

Pertinence is measured in terms of the relation between the state of knowledge, or cognitive information need of the user, and the information objects as interpreted by that user. The criteria by which pertinence are inferred are cognitive correspondence, informativeness, authorship, information preferences and adequacy of form. For instance, a paper may be topically relevant but repeating what the user already knows. Both system and user are included, as the relation depends both on the system's indexing and searching ability to retrieve relevant documents, as well as on the way in which the user formulates the request. This, in turn, depends on the user's IR and conceptual knowledge background and his understanding or perception of his information need. In the case of an intrinsically ill-defined information need at a given point in time, the user may not be able to assess pertinence (Ingwersen, 1992). It may concluded that, if the user has insufficient knowledge and does not have a good grasp of the structure of the task, he will not have the necessary cognition to understand the problem. Cognitive relevance can therefore be described as the ability of connecting a task to prior knowledge (Vakkari & Hakala, 2000).

This type of relevance is also extensively described by Barry (1994) during an empirical study to define the criteria mentioned by users' evaluation of the

information within documents as it is related to their need situations. The study showed that users included tangible features as well as subjective qualities, together with affective and situational factors.

Pertinence was also the term used for the perception of the relevance of a document by an intermediary in connection with the MEDLARS evaluation in a study performed by Lancaster (1968). It should be noted that pertinence in this study has a different meaning.

3.6.4. Situational relevance

Situational relevance describes the relationship between the *perceived* situation, work task or problem at hand and the usefulness of the information objects as perceived by the user. The criteria by which situational relevance are inferred, are usefulness in decision-making, appropriateness of information in problem solving and the reduction of uncertainty. This particular relation encompasses both system and user – the success of the relation depends on the system's indexing and searching ability to retrieve relevant objects, but also on the user's ability to use the information objects for a certain purpose within a given context.

Situational relevance as defined here, is very closely related to task relevance as defined by Reid (1999) as rel(Information, RIN, f(t), {Topic, Task, Context}), which expresses the relevance of information to the user's real information need (RIN) according to topic, task and context at the point in time (t) when the real information need is satisfied. Reid maintains that this type of task relevance does not incorporate assessment as information value in the social context of the task performer, and therefore a task-oriented paradigm for IR is proposed, based on the notion that an IR task comprises four components: formulating an information need, obtaining information, using the information and assessing the success of the process. She then concludes that relevance is not enough; one has to also look at information value that incorporates the broader social environment and the learning process. This is, however, manifested by socio-cognitive relevance discussed below.

3.6.5. Socio-cognitive relevance

Socio-cognitive relevance describes the relationship between the situation, the work-task or problem at hand in a given socio-cultural context on the one hand, and the information objects on the other, as perceived by one or more cognitive agents. The social or organizational domain, or cultural context in which the individual finds himself is defined by a paradigm, which dictates what problem explanations may be found to be acceptable. In the classic Kuhnian sense, paradigms may be exchanged in periods of crisis (Kuhn, 1962). As such, different paradigms will have different "internal" relevance criteria. This type of relevance could also be seen to include the "epistemological view of aboutness" and "epistemological relevance" as alluded to by Hjørland (2000; 2001) and Hjørland and Christensen (2002).

3.6.6. Affective relevance

Affective relevance is described in terms of the relation between the goals, intents and motivations of the user and the information objects. Affective relevance should not be seen as the ultimate subjective relevance in a scale of relevances, but rather as another dimension of relevance judgments that may be associated with the other subjective types of relevance. Success and satisfaction can easily be found to be associated also with topicality.

At this point it would be prudent to add a note on the time dimension encountered in the judgement of relevance by users. The interaction attribute described the dynamic process where interpretations of the other four attributes (as listed in the first column of Table 3.4) may change as the user's cognition changes, as influenced by the time dimension. The time dimension has little influence on algorithmic relevance, but as the relevance judgements become more subjective, changes in cognition over time have an increasingly profound influence on the dynamic process of interpretation, and are especially individualized in affective relevance.

3.7. The contexts of relevance judgements in the information seeking process

According to both Saracevic (1996) and Wilson (1999) there are only two really meaningful models in the area of information searching. These are the episode model of Belkin (Belkin et al, 1995) and Ingwersen's cognitive model of information transfer (Ingwersen, 1996). After Saracevic (1996) discussed these two models, he then developed another model, the stratified model of IR interaction. In describing the Belkin, Saracevic and Ingwersen models hereafter, it has also been explained why the first two models were not deemed suitable for this study, and why the latter has been adapted to a model of relevance types.

In the episode model, Belkin views the interaction with an IR system as a sequence of episodes of different kinds, where the users' interaction with the information is defined as the central process. The IR processes are listed as representation, comparison, summarization, navigation and visualization. Users have different kinds of interactions, dependent on aspects such as the IR goals, tasks, intentions, etc., and these interactions differ because they support different processes, such as interpretation, modification, browsing, and so on. Relevance is thus placed as entering in some, but not all kinds of interaction – summarized by Saracevic (1996) as "in other words, there is more to interaction than relevance, but relevance underlies a number of kinds of interaction."

The focus of Belkin's model is on the actions carried out in an information search. According to this model, any single information-seeking strategy can be described according to its location along the four dimensions of the information search, goal of interaction, mode of retrieval and resource considered.

Although Belkin couches the model in terms of a generalised interaction between the searcher for information and the provider of information, the focus is on the design of IR systems, and is therefore not suitable for the modelling of the relevance types as identified above.

Saracevic's model (1996), the stratified model of IR interaction, has a (simplified) three level structure:

- Surface level: the user interacts with a system through an interface using queries (or commands) that represents the problem statement. From the system side, there is interaction with the user when the system responds to the query with information objects (real or represented), or with further queries to facilitate relevance feedback.
- Cognitive level, where users interact with the output from the system or with the obtained information objects in order to assess the utility of the information in relation to the initial problem.
- Situational level where users interact with a given problem at hand which produced the original need and resulting question, which then may be applied to the resolution (or partial resolution) of the problem, which produced the information need and associated query.

From this stratified model, Saracevic (1996) then identifies the relevance types as discussed in Section 3.2 above. However, it has been shown in Section 3.4 that when the relevance types are modelled against the attributes of relevance, both as identified by Saracevic (1996) that there may be some changes in the relevance types (notably those of motivational relevance as intentionality, affective relevance as a separate dimension of relevance altogether and the introduction of a socio-cognitive relevance). For this reason, the model is not deemed suitable as a foundation for the relevance types as identified in this study.

The third possible model for mapping relevance types is the cognitive model of information transfer (Figure 3.2), as defined by Ingwersen (1996). Saracevic (1996) says the following about this model:

> "Ingwersen's cognitive model of IR interaction includes a comprehensive identification and explication of processes related to cognition in elements involved in IR, namely, information objects (texts), IR systems and their setting, interface, cognitive space of users, and social/organizational environment. IR interaction is viewed as a

> set of processes of cognitive representations and modelling occurring in and between the involved elements. Users interact not only with systems, but with texts, which are cognitive structures considered as an information space. The interactive processes are highly dynamic, involving simultaneous polyrepresentation - multiple representations and models constructed via various elements. Relevance, while not directly addressed in this model, is strongly implied. Cognitive representation and modelling by all participants revolve around or are based on relevance."

The usefulness of the detail and interrelatedness of the various aspects of this model are also noted by Wilson (1999).

Although the concept of relevance was not alluded to previously in the Ingwersen model, this particular model is used because it explores the multifunctional and cognitive array of representations of both the information objects, as well as the cognitive space of the user, both within a particular socio-organizational context.

It is held, specifically by Hjørland (2002), that the Ingwersen model is firmly rooted in the cognitive school of thought, and as such the model is not suitable for application regarding issues dealing with *social cognition*. Despite Hjørland's (2002) *ad hominem* remarks with regard to Ingwersen's viewpoints, the model, as it was published in 1996, clearly includes a *socio-organizational context (or domain)*, which influences systems, users, as well as the information objects. The concept of polyrepresentation, as (also) stimulated by the context of the various role players in information transfer, clearly allows for the inclusion of a socio-cognitive or "epistemological" (Hjørland', 2002) relevance.

Since relevance has always been strongly implied (though not explicitly stated) in the Ingwersen model, and the inclusion of socio-cognitive relevance may certainly be viewed as a valid extension thereof, the different types of relevance can be shown to operate in different dimensions (and over time) of

the information retrieval process by re-organizing the structure of this model (without altering the intrinsic character of the model).

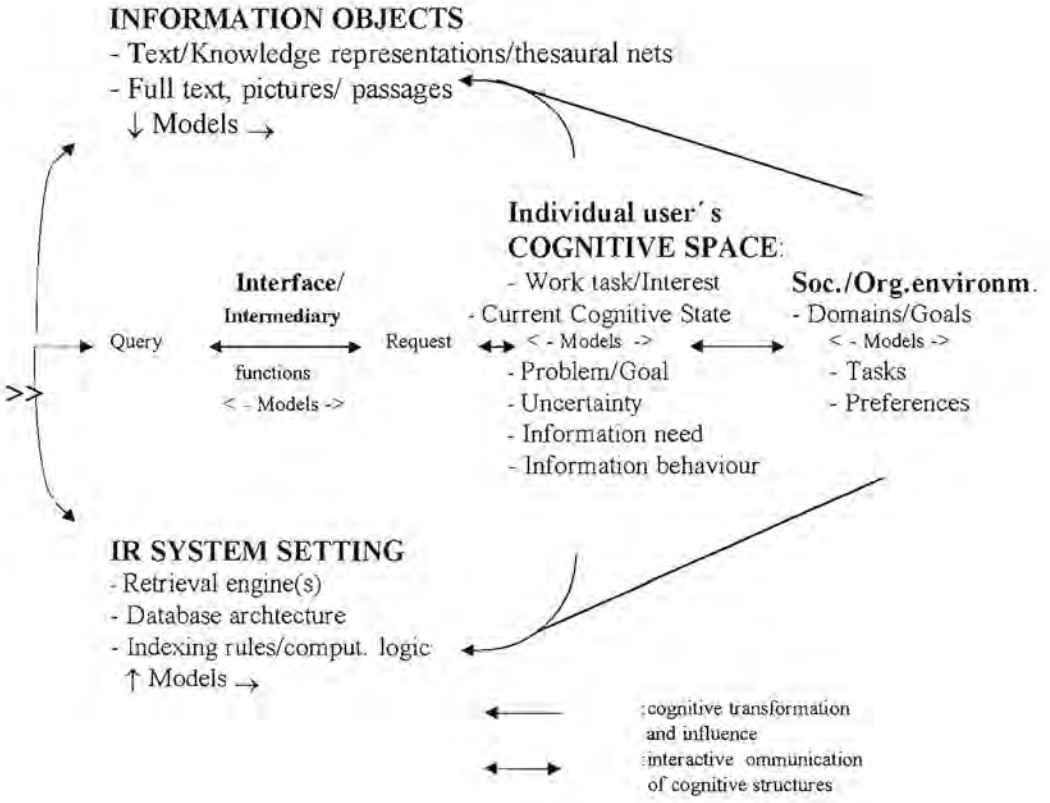

Figure 3.2. Cognitive model of information transfer (Ingwersen, 1996)

As described by Ingwersen (1996), the *information space* consists of two major interactive components: the IR system setting and the information objects. These components in turn are influenced in a cognitive sense by various human cognitive structures. Checkland and Holwell (1998) also describe interactive IR as a pair of systems, one that is served (human cognitive structures), and the other doing the serving (the information space). By restructuring the Ingwersen model the IR process can be shown as a polyrepresentational view of both the information space of the IR system, and the user's cognitive space, including the social and organizational domain in which the individual finds himself (see Figure 3.3). This is done in order to represent the user's information need, problem and state of knowledge, as well as the work task domain as *causal contextual structures*.

The boxes in Figure 3.3 represent the nodes on the Ingwersen model. Boxes with double outlines depict active components. The single-line arrows above the boxes represent interactive processes or actions necessary in the IR and seeking process. The double-line, double-headed arrows below the boxes represent the relevance types as identified above. These structures demonstrate certain contextual properties and these are of utmost importance when studying perception and interpretation, and therefore also the relevance issue.

A *task* is defined as either related to the actual conceptual *work task* or interest, or as the *retrieval* or *search task*. Feedback from a "system" may thus include conceptual information on the work task and information need *and* on performing seeking or search tasks. The system is in the context of the user and the socio-cultural environments and vice versa. Essentially, each box is set in the context of the other boxes or nodes. The model, Figure 3.3, explicitly depicts the spaces of information seeking and retrieval, the latter being incorporated in the former. By replacing the "system" by, for instance, a human being, (e.g. a colleague to the user), the *request* turns into a question to be answered by communication and interaction. The "system" in seeking processes can hence take the form of any system, not only IR systems.

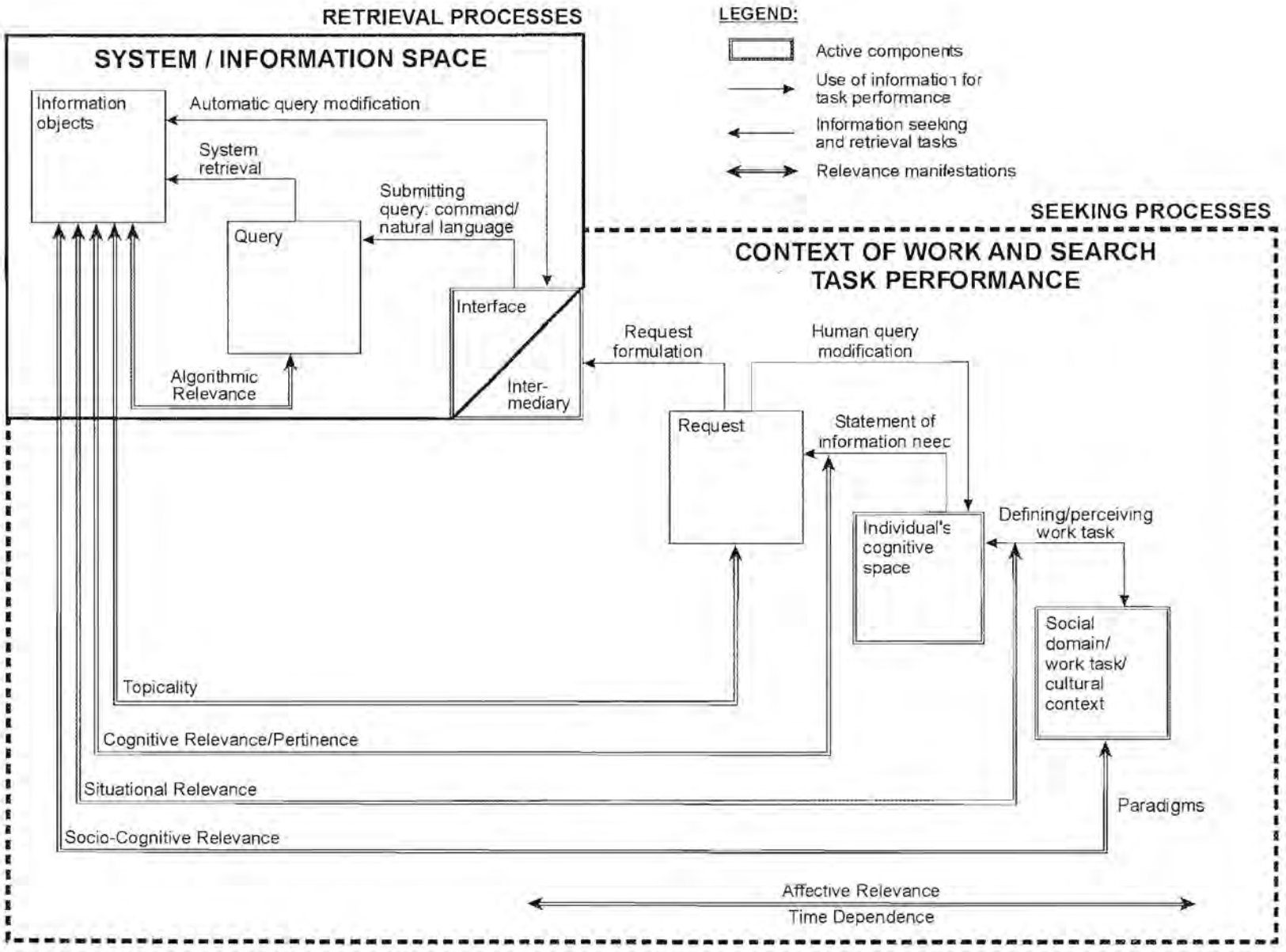

Figure 3.3: Interactive Information Retrieval: Work task performance, search task performance and relevance types

The main elements in the model depicted in Figure 3.3 are defined in detail below.

3.7.1. Social/organizational domain

The social/organizational domain may be defined as a contextual domain of epistemic, social or organizational nature. Ingwersen (1996) further notes that the mental activities taking place within this context, not only influence the *searcher* in a 'historical' socio-semantic sense, but also the *authors/creators* of the information objects and the *designers* of systems. Examples of domains are sectors in industry, academic disciplines, individual companies and professional groupings. See also the discussion in the introduction of Section 3.7 regarding the importance of correctly interpreting this element in the Ingwersen model.

3.7.2. Defining/perceiving the work task

It is important to distinguish the work task from the search task. The work task is defined and outlined by the context as described above. Work tasks can be of varying complexity. The degree of complexity of the work task has a direct influence on the information seeking behaviour, the information need of the user and the amount of information needed to accomplish the task (Byström & Järvelin, 1995). This definition can also be broadened to include interests as well as work tasks. In this case broader cultural groupings, situations or even global paradigms may be seen as the context in which the individual exists.

3.7.3. The individual's cognitive space

The current cognitive state of the user/searcher is defined by Ingwersen (1996) as that which is currently known. It draws not only on the tacit knowledge of the user, but also on emotions and various external factors and situations that influence the user at a particular point in time. It is clear that this state of knowledge is variable over time, but may be assumed to be stable for the period of time when dealing with certain kinds of information requirements (e.g. verifying information objects when certain aspects of the object are known). Depending on the outcome of the system, this cognitive state may change from stable to variable, and vice versa.

3.7.4. Statement of information need

The need for information is expressed when the individual cognitive space processes a situation in such a way that there is a recognition of inadequate knowledge. This has *inter alia* been described as a "knowledge gap" by Dervin and Nilan (1986), or "Anomalous State of Knowledge (ASK)" by Belkin (1978).

3.7.5. Request and request formulation

The formulation of the information need as perceived by the user is either posed to an intermediary searching on behalf of the end-user or directly to the system by way of an interface. It is in this formulation process that the user has to have a focused perspective on the topic. Focusing can be seen as a graded process of pre-focus where thoughts are fragmented, vague and general; the focusing phase, which facilitates directed searching and the post-focus phase in which searches are specific and concentrated (Vakkari & Hakala, 2000)

In Lancaster's 1968 study in connection with the MEDLARS evaluation, pertinence was the term used for the perception of the relevance of a document by an intermediary. It should be noted that pertinence in this study has a different meaning.

The five conceptual elements as defined above relate to the *execution* of the *seeking task* when moving from right to left on the model (Figure 3.3), or the *use* of information to perform the *work task* when moving from left to right in the figure. The significance of this aspect will be discussed in Section 3.8 of this chapter.

3.7.6. Interface/Intermediary

The interface may be defined as a mechanism and the intermediary as a human placed between the user and the retrieval setting. During retrieval the interface forms part of the information system seen from the searcher's point of view, the latter acting as its current context set in a socio-cultural environment, refer to the centre and right-hand side of Figure 3.2. It is through this human/machine interface that the request is formulated into a query. The query is then submitted and may be, depending on the system, either in natural language or by means of a command language.

3.7.7. Information objects

One may say that relevance always implies a relation. In the scheme of relevances above this relation is between some entity and the information object(s). If one interprets information objects in the broadest sense, they can be defined as anything conveying information – more traditionally full-texts, but also including, for example, passages, text representations and images. This broad definition has implications for the role that *time* plays in the information seeking and retrieval interaction process. As mentioned, when

discussing the social and organizational domain, the authors or creators of these information objects are also influenced by the contexts and situations in which they operate.

3.8. Work task and search task as depicted in the model

IR is described as a part of the bigger process of information seeking (IS) (Ingwersen, 1996; Belkin, 1978; Vakkari & Hakala, 2000). IS is the process of searching, obtaining and using information for a specific purpose when the person does not have sufficient prior knowledge, be it lack of IR knowledge or lack of conceptual knowledge regarding the real or perceived problem at hand. IR on the other hand, is seen as the process of using an information system for obtaining information relevant to a specific purpose (Ingwersen, 1992; Vakkari & Hakala, 2000). The model, Figure 3.3, restructures Ingwersen's model, Figure 3.2, in that it places into perspective *which* of the interactive processes concern seeking of information and IR, as well as which types of tasks and relevance are functioning during seeking and retrieval of information.

Task performance is defined here as the work task, seen separate from the search task. During the fulfilment and performance of the work task, the information needs and knowledge states of the users change, and therefore one can say that the search task is an iterative process, although very different from the iterative process of using information, until the work task has been completed. The model stresses the distinction between the *use* of information in *work* task performance and in *search* task activities, as well as relevance assessments. The latter (relevance assessments) signify perceptions of the *conceivable use* of information objects in accordance with their topicality, their additional features in relation to a knowledge gap and their usefulness as to a work task, also within a social context. The actual use of information from the objects and system features fed back to the user is a function of the relevance assessments. The necessity of the opposite activity

of relevance feedback then becomes apparent, since it becomes a part of the search task informing the system.

In using Ingwersen's cognitive model of information transfer as the basis for modelling the various types of relevance identified, the information space context can be shown as separate from the cognitive and domain contexts. The *use* of retrieved information by perception and interpretation for the work task is strictly speaking not dependent on the context of the system or information space. The contexts of the user's cognitive space and the socio-organizational domain, from where the work task is generated, may be labelled as the context of fulfilling the work task. However, the system's way of presenting the information naturally influences the perception.

Moving from the right to the left in Figure 3.3, one may say that this represents the *search task*. Returning to the active components in the process, (as explained by Ingwersen (1996)), this process, as shown by the single-line, double-headed arrows, is an interactive communication of cognitive structures, depending on the user's focus (pre-focus, focus or post-focus) on the perspective of the task (Vakkari & Hakala, 2000). It is also clear that this is a cyclical and iterative process, which depends on the stability of both the user's information need and the work task. Different aspects of relevance come into play at different stages of the process. For example, an information object may be topically relevant during the pre-focus phase of the query formulation, but cognitively and situationally irrelevant when the formulation focus has been established. It is clear that relevance types will differ even more when the seeking process is observed over a longer period of time.

If we move from left to right in the model, limited to the area demarcated as *the context of task performance*, we notice that this can also be seen as a cyclical and iterative process of using information in order to perform a certain work task. This is also dependent on the user's cognitive state and the

perceived work task. Once again, the various relations described by the types of relevance may be observed at different stages of the task performance.

Two empirical studies, the first by Barry and Schamber (1998) and the second by Vakkari and Hakala (2000), have been discussed in the following section in order to identify possible criteria by which users judge the relevance of documents used during the execution of both the work task and search task. The purpose of this consolidating of relevance criteria is to establish the validity of the model described in Section 3.7 as a model of relevance types as perceived by actual users.

3.9. User criteria for relevance judgments

Several empirical studies of user relevance judgments have been undertaken in the past, and it is a long recognized fact that there are a variety of factors that influence relevance judgments in information seeking and use. In this study, the user relevance criteria identified by Barry and Schamber (1998) and Vakkari and Hakala (2000) were selected to review and to analyse the categories of user criteria identified when judging relevance.

These two studies were chosen for the pre-testing of the viability of the model, because they were both fairly large-scale, longitudinal studies where responses were elicited from the users themselves. Most of the other empirical studies on relevance focus on a narrower aspect of relevance judgement, for example, degrees of relevance (Spink & Greisdorf, 2001; Spink et al., 1998) or interactive IR (Borlund, 2000).

Barry and Schamber combined the results of two separate studies on relevance criteria in order to establish whether there is a "finite array" (Barry & Schamber, 1998) of user relevance criteria. The result of the study indicated that this array does indeed exist and is also finite, and that it is applied consistently across types of information users, problem situations and source

environments (Barry & Schamber, 1998). This classification scheme is represented below in Table 3.5.

Table 3.5. Barry and Schamber (1998) relevance criteria

Relevance criteria	Description
Depth/Scope/Specificity	Focused, specific to user's needs, sufficient detail or depth, interpretation, etc.
Accuracy/Validity	Accuracy, correctness and validity of information
Clarity	Presentation of information in clear or well-organized manner
Currency	Current, recent, up-to date, timely
Tangibility	Extent to which information relates to real, tangible issues, proven information, hard data, actual numbers
Quality of sources	General standards of quality, reliability
Accessibility	Effort and costs
Availability of Information/ Sources of information	Availability
Verification	Consistent with or supported by other information in the field. Agreement with user's point of view
Affectiveness	Affective or emotional response to information (e.g. pleasure, enjoyment or entertainment)
Effectiveness	The extent to which a procedure that is presented is effective or successful
Consensus within the field	Consensus or agreement in the field relating to the information being evaluated
Time constraints	Are time constraints or deadlines a factor in deciding whether or not to pursue information
Relationship with author	User's personal or professional relationship with author
Background/experience and ability to understand	User's background and experience helps to judge quality, reliability, or understanding of the issues
Novelty	Document novelty, source novelty and content novelty
Geographic proximity	Geographic location covered in document may not be relevant to user's situation
Dynamism	Presentation of information: live or dynamic. Can user manipulate the presentation of information
Presentation quality (excluding entertainment value)	Format or style of presentation

The aim of the Vakkari and Hakala study was to analyse how changes in relevance criteria are related to changes in the problem stages during task

performance processes. Using Kuhlthau's (1993) task performance process, consisting of six phases, it was concluded that the user's relevance criteria are (partially) dependent on the stage of the task performance process (Vakkari & Hakala, 2000). The relevance criteria employed by the Vakkari and Hakala study are listed in the table below.

Table 3.6. Vakkari and Hakala (2000) relevance criteria and sub-categories

Relevance criteria	Subcategories
Information content	Topicality Point of view Recency Discipline Geographical area References Examples Clarity Research approach
Sources of documents	Person's relation to sources Source type Author
Document as physical entity	Availability Length
User's situation	Time constraints Stage of the process
User's experience and preferences	Ability to understand Language Interest Novelty Saturation
Information types	General information Specific information Theories Methods Empirical results

In analysing these two research programs, it was found that the type of situation, the work task, the field or domain and the research designs differed, but despite this, certain criteria were present in both studies. It was therefore

possible to identify some important concepts pertaining to the manner in which users judge the relevance of information objects utilized. The criteria identified in this process were then consolidated, analysed and allocated to the corresponding manifestations of relevance and relevance types as identified in Section 3.7 above.

It is noticeable that the concept of *algorithmic or system relevance* is not pursued to any large extent in either of the studies described above. A possible reason for this may be that users have no control over the matching of the query to information objects in the retrieval system, and therefore do not judge relevance on this essentially system level. This is once again a clear indication of the relevance dichotomy as discussed in Chapter 2.

In the Barry and Schamber (1998) study (Table 3.5), the concept of *topicality* or *aboutness* is not mentioned explicitly, but can be seen as inherent in several of the relevance criteria mentioned in the first column. The Vakkari and Hakala study (2000), as well as the subsequent articles by Vakkari (2001a and 2001b) found that the largest number of relevance judgements by the respondents were based on *topicality*, as a single relevance criterion. In this study, it is argued that the use of such a broad categorization is not necessarily meaningful.

The criteria of *accessibility/availability*, *tangibility* and *viewpoint congruence* in the first column of Table 3.7 are regarded by some authors (e.g. Vakkari & Hakala (2000)) to be of a topical nature. In this study, they are not regarded as instances of topical relevance. Topical relevance is clearly defined as the relation between the subject or topic expressed in the request and the subject or topic of the information objects (see Table 3.1), and this relation is measured in terms of aboutness. The criteria mentioned above deal with cognitive, situational, socio-cognitive or affective judgements, and not with the aboutness of the information objects.

Consequently, the concept of topical relevance will also be excluded to a certain degree from this particular modelling process, while the subjective relevance types, namely cognitive, situational, socio-cognitive as well as affective relevance will be included. Certain criteria satisfied their inclusion in more than one category (see Table 3.7).

Table 3.7. Criteria pertaining to relevance types

Criteria	Pertains to...	Relevance type
Scope/Depth/ Specificity	Information need (background or specific)	Cognitive
	Usefulness (sufficient detail/depth)	Situational
Accuracy/ Validity	Usefulness (accuracy, correctness and validity related to a work task)	Situational
	Organisational or social environment (acceptable or suitable)	Socio-cognitive
Accessibility/ Availability	Must be accessible and/or available within a work task or situation	Situational
	Emotions of frustration or satisfaction	Affective
Clarity	Information presented clear enough to satisfy need	Cognitive
	Usefulness in terms of problem solving within research focus	Situational
Currency	Current/recent in terms of personal information need	Cognitive
	Current/recent in terms of work task/situation	Situational
Tangibility	Extent to which information relates to real needs with regard to proven information, hard data, facts and figures	Cognitive
	Work task and socio-organizational environment (require hard data, e.g. decision-making)	Situational Socio-cognitive
Expertise	User's own state of knowledge with regard to the information need	Cognitive Situational
	Author's expertise - both in terms of the work task and acceptability in organizational environment	Situational Socio-cognitive
Presentation/ Format	Usefulness of format or presentation style for a particular work task	Situational
	Socio-organizational acceptance	Socio-cognitive
	Emotions (frustration, satisfaction, aesthetics, etc)	Affective
Quality	Usefulness in terms of reliability and standards of quality within a particular work task	Situational
	Emotional response (anger, frustration, elation, etc)	Affective
	Socio-organizational acceptability	Socio-cognitive
Author	Emotional response (like or dislike, professional or personal relationship with the author)	Affective
	Socio-organizational acceptability	Socio-cognitive
Viewpoint congruence	Consistent with or supported by other information in the field	Socio-cognitive
	Emotional response (anger, satisfaction, etc). Agreement with user's point of view	Affective
	Information need (supports current state of knowledge)	Cognitive
Novelty	Information need (enhances current state of knowledge)	Cognitive

In the table above, the relevance criteria used in the Vakkari and Hakala study, as well as the Barry and Schamber study were consolidated and listed in the first column of the table. The second column describes the "situation" to which the criteria identified in the first column pertains in terms of the user's judgment of the information object. The third column then couples them to specific relevance manifestation as described in Section 3.6 above.

The purpose of this table is to show that the relevance types as identified in Section 3.6, can in fact be related to practical relevance judgments made by actual users as described in various empirical studies. This summarizing and consolidation of these empirical studies on the relevance judgments of actual users, and their ability to be linked to the relevance types shows that the model described in Section 3.7 is, in principle, a viable model to utilize in empirical testing of relevance judgments by users.

3.10. Summary and conclusions

The line of argument followed in this chapter may be summarized as follows:
In Section 3.4 the attributes and manifestations of relevance as defined by Saracevic (1996) were modelled in a matrix in order to define the various relevance types more clearly.

In Section 3.7 the identified relevance types as described in Section 3.4 were modelled on an existing cognitive model of information transfer, as defined by Ingwersen (1996). The Ingwersen model was utilized because it explores the multifunctional and cognitive array of representations of both the information objects, as well as the cognitive space of the user. By the re-organization of this model, the different types of relevance were shown to operate in different dimensions (and over time) of the information retrieval process.

Section 3.9 identified the key concepts pertaining to the manner in which users judge the relevance of information objects utilized, by using the

published results of the empirical studies, by Barry and Schamber (1998) and Vakkari and Hakala (2000). The criteria identified in this process were then consolidated, analysed and allocated to the corresponding manifestations of relevance and relevance types, as identified and modelled in Sections 3.4 and 3.7, excluding the more "objective" relevance types, over which the user does not have much control.

The fact that the allocation of the relevance types as identified in the models described in Sections 3.4. and 3.7 could be ascribed in a clear and methodical fashion to the empirical data described in Section 3.9, seems to indicate that the relevance types, as depicted in Figure 3.3, would in all likelihood, be a viable model to use when performing empirical studies on the testing of relevance judgments by users of information objects. This model has the added advantage that it may be possible to specify whether relevance judgments were made during the work task or the search task execution.

In order to test the validity of this model, an empirical study was undertaken. The formulation and construction of a questionnaire for this study is described in the next chapter.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

In Chapter 3 it was described why the model depicted in Figure 3.3 is a viable model to study relevance judgements made by users during work task and search task performance. This chapter will describe the methodology used in order to test various aspects of the model. The research questions will be restated, and the testing of the research questions will be described in terms of the methods of data collection, the rationale behind and the structure of the questionnaires employed, the editing and analysis of the data, as well as some comments on the limitations of this method of testing.

4.1. Defining the research question

As stated in Chapter 1, the main research question that will be addressed can be formulated as follows:

> *How useful, in terms of understanding relevance, is it to define relevance types by means of relations between elements in the process of information transfer?*

In order to answer this question, the generally accepted categorization of relevance types by Saracevic (1996) have been analysed in detail in terms of the attributes inherent in relevance judgements after which a modified relevance model have been constructed. The questionnaires of which the construction will be described in this chapter, will be used to test various aspects of this model empirically. The following sub-questions are also addressed:

1. *Is this categorization of relevances a viable way of typifying relevance types?*

Before any empirical work could be done, it had to be established that the model, as depicted in Figure 3.3 (Chapter 3) is a viable way to typify relevance types. Utilizing previous empirical data and "back-mapping" to the

model, as described in Chapter 3 is assumed to answer this research question.

2. *To what extent does the nature of the work task influence the application or non-application of documents in work task fulfilment?*

The empirical data collected represent at least three different work tasks. This will be utilized to answer this particular research question.

3. *Which types of relevance judgements are made during the process of seeking for information (search task) and which are made while using information (work task)?*

The hypothesis related to this question could be stated as follows:
The *modelling process* would seem to indicate that the relevance types of pertinence and topicality might feature to a larger extent within the search process, especially if the search task is monitored over a single session (please note: as *based on the modelling process, not the empirical data*). Situational relevance and socio-cognitive relevance might be more important measures of relevance during the performance of the work task, as time-dependency plays a greater role in this task.

4. *To what extent are the identified relevance types "nested"? In other words, are certain relevance judgements by definition included within other types of relevance judgements?*

From the stratified model of relevance types by Saracevic (1996), as well as Borlund's studies (2000), it would seem that some authors in the field view relevance types as inherently "nested". It could be argued, for instance, that if an information object is judged relevant on a cognitive level, it should also be relevant on a topical and algorithmic level. The assumption for this study is that this is not necessarily true. It is quite possible that an information object may be judged as relevant on, for example, a situational level, but not relevant on a topical level. It is assumed that relevance types are distinct, and may sometimes be nested, but not as a rule.

5. *To what extent are affective relevance judgements made in conjunction with the other relevance types?*

Affective relevance is a very subjective issue and in the model described in Chapter 3, identified as a separate and very different dimension of relevance type (as opposed to Saracevic who views affective relevance on the same scale of relevances as the other subjective relevance types). It is assumed in this study that affective relevance judgements may be made together with other types of subjective relevance judgements.

6. *Does socio-cognitive relevance exist separately from cognitive relevance?*

The model as described in Chapter 3 is the first of its kind to include the concept of socio-cognitive relevance, and criticism of this inclusion is mainly due to the fact that the relevance model is based on Ingwersen's model of cognitive information transfer. It is held (Hjørland, 2002) that the Ingwersen model is firmly rooted in the cognitive school of thought, and as such the model is not suitable for application regarding issues dealing with *social cognition* (see also Section 3.7). This sub-question will therefore serve to establish whether there is in fact a type of relevance that may be termed socio-cognitive relevance and whether it can be viewed as distinct from the other types of subjective relevances.

4.2. Construction of the questionnaire

Questionnaires are complex data collection instruments. General guidelines provided by Bless and Higson-Smith (1995) were employed to draft the questionnaire. The guidelines employed in this study were based on preliminary research by Oosthuizen (2001). The final questionnaires used in the empirical study are included in Appendix A.

4.2.1. Length of the questionnaire

Authors on research methodology (Bless & Higson-Smith, 1995; Neuman, 1997) emphasise that the length of the questionnaire should not be daunting to the respondent. This particular questionnaire had three sections containing 9, 24 and 25 questions respectively:

Section A had to be completed only once, in order to establish the context within which relevance judgements were being made;
Section B, however, had to be completed for every document used; and
Section C for every document at least partially read and then not used.

The number of questions that had to be answered by each respondent therefore depended on the number of documents utilized to various degrees by the respondents within a particular information use situation.

This could breach the general guidelines regarding length of questionnaire construction, but in the final analysis of the questionnaire it was decided that this was the only way to elicit responses valid and reliable enough to test the research questions.

4.2.2. Language and vocabulary

When constructing questionnaires, the language and vocabulary used in the questionnaire should be adapted to a level where the respondent would understand and feel comfortable with the language use. The respondents of this questionnaire were students, academics and professional persons, and the type of language used (in terms of understanding) was not really perceived as an issue. Domain-specific language use was also not a problem, as most of the respondents were researchers on an advanced level within a particular domain.

4.2.3. Wording of the questions

Bless & Higson-Smith (1995) state that in the wording of questions, the following should be taken into account: questions should be simple and short, worded unambiguously, easily understood, and should avoid double-barrelled and leading questions.

In constructing this questionnaire, it was endeavoured to follow these guidelines. Due to the length of the combined questionnaires, this was a particularly important issue – it had to be made as easy as possible for the respondents to complete the questionnaire.

4.2.4. Sequence of the questions

When constructing questionnaires, it is important that the initial questions should put the respondent at ease, and should therefore be either general or factual in nature. Later questions then move to be more specific.

Section A of this questionnaire is the contextualisation of the information use situation. The initial questions deal with facts, such as the name and date of the conference (in the case of conference papers), or the degree course and topic of the thesis (in the case of theses and research essays). The later questions in section A deals with specific and personal perceptions of the users' state of knowledge as well as the intended audience's understanding of the topic.

Sections B and C also follows this sequence by starting off with factual information regarding the particular document being evaluated before moving to questions regarding perceptions and value judgements.

4.2.5. Types of questions

It is possible to use a variety of question types when constructing a questionnaire – this include factual questions, opinion questions, state of action questions and questions about acts in the past or present (Neuman, 1997). These questions can be open-ended or closed, and it is also possible to use scaled responses. The question type is dependent on the type of data required by the researcher.

In this case both open-ended and closed questions (mostly fixed response through tick boxes) were utilized. Open-ended questions were typically utilized to ensure that respondents are not forced to supply incorrect answers if a suitable option was not represented in the tick boxes, as well as to ensure that a statement of opinion is not forced where there is none. Other fixed responses were required through the use of itemised rating scales and summated scales.

4.2.6. Question content and selection

The questions asked in this questionnaire relate to the identified research questions. All the necessary issues were identified and it was established which questions were needed to obtain the necessary data. The technique utilized to identify redundant questions was the variable-question matrix (Powell, 1997). Variable-question matrices are used to ensure that all necessary variables are covered in sufficient detail for the researcher's data requirements. The questions are listed as columns and the variables influencing the relevance judgements on the user (in this case derived from Table 3.7) as rows. The matrices are illustrated in Tables 4.1 and 4.2 for Sections B and C of the questionnaire respectively.

Table 4.1. Variables to questions matrix: Section B

	Question numbers in Section B of the questionnaire																						
Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Scope/Depth/ Specificity	Bibliographic details of the document	X	Degrees of usefulness	Importance in terms of formulation of focus	X	X								Influences of other people on what users read and use				Affective issues regarding font type, font size, layout of document, colours used in document and writing style					Check question for questions 3 and 4: importance in terms of work task	Was the judgement made during work task or search task?
Accuracy/ Validity		X														X								
Accessibility/ Availability		X																						
Clarity					X											X	X							
Currency																X								
Tangibility		X			X																			
Expertise		X					X																	
Presentation/ Format		X															X							
Quality		X									X	X												
Author		X							X							X								
Viewpoint Congruence		X			X			X		X			X			X	X							
Novelty		X			X											X								
Algorithmic		X																						
Topicality		X																						

Table 4.2. Variables to questions matrix: Section C

	Question numbers in Section C of the questionnaire																							
Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Scope/Depth/ Specificity	Bibliographic details of the document	Stage of search task when relevance judgement was made.	X	X												Influences of other people on what users read and use				Affective issues regarding font type, font size, layout of document, colours used in document and writing style.					Was the judgement made during work task or search task?
Accuracy/ Validity								X										X						
Accessibility/ Availability			X																					
Clarity			X															X	X					
Currency							X											X						
Tangibility			X		X																			
Expertise			X						X															
Presentation/ Format																			X					
Quality						X							X	X										
Author											X							X						
Viewpoint Congruence			X							X		X			X			X	X					
Novelty			X															X						
Algorithmic																								
Topicality			X																					

4.3. The questionnaire

Initially, the specific research issues which were to be investigated were listed. Several empirical studies of user relevance judgements have been done in the past, and it is a long recognized fact that there are a variety of factors that influence relevance judgements in information seeking and use. In this study, the user relevance criteria identified by Barry & Schamber (1998) and Vakkari & Hakala (2000) were selected to review and to analyse the categories of user criteria identified when judging relevance. These two studies were then combined and mapped to the relevance model as described in Chapter 3. The extended table derived in Chapter 3 (Table 3.7) was then used to code the questionnaires as indicated in Table 4.3 below, with topicality and algorithmic relevance added.

Table 4.3. Codes used for relevance types in questionnaires

Criteria	Pertains to...	Relevance type	Code
Scope/Depth/ Specificity	Information need (background or specific)	Cognitive	1
	Usefulness (sufficient detail/depth)	Situational	2
Accuracy/ Validity	Usefulness (accuracy, correctness and validity related to a work task)	Situational	3
	Organisational or social environment (acceptable or suitable)	Socio-cognitive	4
Accessibility/ Availability	Must be accessible and/or available within a work task or situation	Situational	5
	Emotions of frustration or satisfaction	Affective	6
Clarity	Information presented clear enough to satisfy need	Cognitive	7
	Usefulness in terms of problem solving within research focus	Situational	8
Currency	Current/recent in terms of personal information need	Cognitive	9
	Current/recent in terms of work task/situation	Situational	10
Tangibility	Extent to which information relates to real needs with regard to proven information, hard data, facts and figures	Cognitive	11
	Work task and socio-organizational environment (require hard data, e.g. decision-making)	Situational Socio-cognitive	12 13
Expertise	User's own state of knowledge with regard to the information need	Cognitive Situational	14 15
	Author's expertise - both in terms of the work task and acceptability in organizational environment	Situational Socio-cognitive	16 17
Presentation/ Format	Usefulness of format or presentation style for a particular work task	Situational	18
	Socio-organizational acceptance	Socio-cognitive	19
	Emotions (frustration, satisfaction, aesthetics, etc.)	Affective	20
Quality	Usefulness in terms of reliability and standards of quality within a particular work task	Situational	21
	Emotional response (anger, frustration, elation, etc.)	Affective	22
	Socio-organizational acceptability	Socio-cognitive	23
Author	Emotional response (like or dislike, professional or personal relationship with the author)	Affective	24
	Socio-organizational acceptability	Socio-cognitive	25
Viewpoint congruence	Consistent with or supported by other information in the field	Socio-cognitive	26
	Emotional response (anger, satisfaction, etc.). Agreement with user's point of view	Affective	27
	Information need (supports current state of knowledge)	Cognitive	28
Novelty	Information need (enhances current state of knowledge)	Cognitive	29
Algorithmic	Machine matching	Algorithmic	30
Topicality	Aboutness	Topicality	31

The table below (Table 4.4) tabulates the relevance criteria against the relevance types in order to show where each of the identified numbered elements in Table 4.3 may be mapped. The numbers underneath the text in each cell correspond to the numbers in the last column of Table 4.3. In the table below, algorithmic relevance and topicality have not been indicated.

Table 4.4. Relevance criteria within relevance types

Relevance Type / Criteria	Cognitive Relevance	Situational Relevance	Socio-Cognitive Relevance	Affective Relevance
Scope/ Depth/ Specificity	Information Need (background or specific) 1	Usefulness (sufficient detail/depth) 2		
Accuracy/ Validity		Usefulness (accuracy, correctness and validity related to a work task) 3	Acceptable or suitable within an organisational or social environment 4	
Accessibility/ Availability		Must be accessible and/or available within a work task or situation 5		Emotions of frustration or satisfaction 6
Clarity	Information presented clear enough to satisfy need 7	Usefulness in terms of problem solving within research focus 8		
Currency	Current/recent in terms of personal information need 9	Current/recent in terms of work task/situation 10		
Tangibility	Extent to which information relates to real needs with regard to proven information, hard data, facts and figures 11	Work task and socio-organizational environment (require hard data, e.g. decision-making) 12 13		

Relevance Type / Criteria	Cognitive Relevance	Situational Relevance	Socio-Cognitive Relevance	Affective Relevance
Expertise	User's own state of knowledge with regard to the information need 14 15	Author's expertise - both in terms of the work task and acceptability in organizational environment 16 17		
Presentation/ Format		Usefulness of format or presentation style for a particular work task 18	Socio-organizational acceptance 19	Emotions (frustration, satisfaction, aesthetics, etc) 20
Quality		Usefulness in terms of reliability and standards of quality within a particular work task 21	Socio-organizational acceptability 22	Emotional response (anger, frustration, elation, etc) 23
Author			Socio-organizational acceptability 25	Emotional response (like or dislike, professional or personal relationship with the author) 24
Viewpoint congruence	Information need (supports current state of knowledge) 28		Consistent with or supported by other information in the field 26	Emotional response (anger, satisfaction, etc). Agreement with user's point of view 27
Novelty	Information need (enhances current state of knowledge) 29			

The specific types of data needed to examine these issues were identified and thereafter the questions were formulated. The research issues were therefore not modified to fit the questions, but the questions were formulated around the research issues.

It is important to note that the questionnaire calls for much more data than required to answer the research questions. The reason for this is that future research will be conducted using this data. For the purpose of this thesis, only the answers to some of the questions will be utilised in order to justify the proposed model (as depicted in Figure 3.3) and the related research questions dealing with the model.

The questionnaire consisted of three sections:
Section A (9 questions) was completed only once by each respondent and serves as a contextualisation of the relevance judgements. Here the respondents had to indicate in which socio-organizational domain the work task originated and was completed.

Section B (24 questions) tries to establish why users found a particular document relevant. This section of the questionnaire had to be completed for every relevant document that was usable to such an extent that is was included in the bibliography of the conference paper or thesis.

Section C (25 questions) had to be completed for every document that was retrieved and at partially least read, but for some reason not used to such an extent that it had to be included in the bibliography. The reason for including this section was to establish why users don't use some documents, and also to try and establish at what stage in the research process the users decided that a particular document was not relevant to the work task.

The three sections of the questionnaire are discussed in more detail below, but it is important to realize that the different sections and the questions

should not be viewed in isolation. The questionnaire has an interrelated nature where responses in one section are needed to analyse responses in another. Evaluation of documents used and regarded as relevant as well as documents read and regarded as non-relevant are needed to build a case for or against the validity of a particular relevance type.

4.3.1. Section A: context of information seeking and use

Section A consists of general questions relating to either the conference paper and the conference, or the topic of the respondents' thesis or research paper and the context in which it was written. The purpose of this section is fourfold:

- To ease the respondent into the process by asking non-threatening, factual questions
- To establish the context of the questionnaire for the respondent
- To establish the context of the respondent's own research
- To elicit the necessary factual information.

The necessary factual information includes, for example, the topic of the paper. This information is needed to evaluate the validity of topicality as a manifestation of relevance. The question regarding the primary focus of the paper is necessary because identifying documents either used or not used in relation to the focus of the paper can give an indication of the basis of the relevance judgements made by the respondent. The questions pertaining to the state of knowledge before and after the completion of the paper are likewise necessary to establish the subject knowledge of the respondent's regarding their own research.

4.3.2. Section B: documents used to complete the work task

Section B consisted of 24 questions to be answered for each document used and cited. It is assumed that these documents represent information objects

that were judged relevant by the respondent. It is also assumed that the entire document has been read. The aim of this section of the questionnaire was then to determine if the basis of these relevance judgements corresponds to the manifestations of relevance as identified in the relevance model presented in chapter 3. Each of the questions will be discussed below in order to indicate the function of the question in the questionnaire. Where applicable, numbers in brackets refer to the numbers in the cells (relevance criteria within relevance types) in Table 4.4.

Question 1: Bibliographic details of the document

The first question recorded the bibliographic information for each of the documents. Respondents had to either write the full bibliographic details of the information object used, or attach a copy of the bibliography to Section A and cross reference the records to Section B and C of the questionnaire.

Question 2: Why did you use this document?

This question remains more general than the later questions in accordance with the guidelines for questionnaire construction. In order to avoid bias, the term "relevance" was not used in the questionnaire. The question "Why did you use this document?" therefore actually refers to the reasons for the document being judged relevant. This particular question tries to establish according to which of the relevance categories the document is being judged.

The underlying assumption of this question (question 2) is that if the respondent only used the document because the topic of the document matched the topic of the query (30), a strong case can be built for the validity of topical relevance (31) if a statistically significant number of respondents provide this response.

If the majority of responses indicate that documents were perceived as being relevant based on the relations between the information object and the user's current cognitive state (28) and/or the socio-cognitive acceptability of use (26)

and/or the usefulness of the document for a particular work task (3), then a clearer understanding of the existence of these relevance types can be obtained. Response option 3 ("This document supports my approach to the topic" – (28)), for instance, deals with the respondent's current state of knowledge or cognition. If the respondent perceived the retrieved document as being relevant because it supports the current state of knowledge (congruent viewpoints), then it could indicate that the relevance type defining a relation between the user's state of knowledge and the information objects (where the judgements are content dependent) is a valid construct. However, it has to be analysed in conjunction with the responses to the rest of the questionnaire. It could, for instance, happen that a strong case for the validity of cognitive relevance be made here, but that later in Section C of the questionnaire the respondent indicates that although a document contained information that was not previously known to him/her (novelty), the document was still not perceived as relevant. Cases like these have the potential to throw more light on the way respondents make their relevance judgements in terms of the relative importance of identified factors in the context in which respondents find themselves at specific points in time.

Response option 5 in question 2 relates to accessibility of the information object (5). The relation inherent to situational relevance is between the work task at hand and the information objects. Under normal conditions of information use it can be presumed that the document will not be judged relevant if it is not useful for completion of the work task. However, if the affective responses of frustration or worry about not finding anything come into play, the document might then be judged useful. In the same way, as the time limits become a crucial factor, a document that might, under other circumstances, not have been judged useful, can become useful if nothing else can be found. Therefore, an affirmative response to option 5 taken in isolation, might mean that the document was useful, but viewed in conjunction with other options, might be an indication of affective relevance and the influence of time-constraints on the user. Vakkari and Hakala (2000) also

concluded that relevance judgements are dependent on the stage of the information seeking and use process. Once again, this analysis cannot be conclusive without regard for the responses to the rest of the questionnaire.

Options 4 ("The viewpoint of this document is in accordance with the approach of the conference theme" – (26)) and 6 ("I know the work of this author" – (24)) pertain to the manifestation of socio-cognitive relevance. In option 4 the conference is the socio-organizational environment in which the work task takes place. The cognitive model of information transfer as proposed by Ingwersen (1996), indicates that the socio-organizational environment of the user influences of the cognitive space with regard to the work task, current cognitive states, problems or goals, uncertainty, information need and information behaviour. If the information behaviour (using document) only takes place because of perception of the respondent regarding what is right and necessary within the conference context, then a strong case can be built for the validity of socio-cognitive relevance type (indicating a relation between a situation, task or problem at hand as perceived in the socio-cultural context and the information object). Furthermore, option 6 may indicate that the socio-cognitive relevance type is possibly valid based on the fact that the author's work is used because it known (i.e. acceptable within the academic environment in which a respondent functions). It may, however, also be seen as an affective relevance judgement if it can be shown, together with the response to Question 9, that there is an emotional like or dislike of, or professional or personal relationship with the author.

It can be seen from the discussion that the question 2 is necessary for the comparative analysis of the further responses provided by the respondents.

Question 3: How useful was this document to you?

This question is a three point scale trying to quantify the usefulness of the information object. The concept of usefulness is described as a criterion for

success of situational relevance (see Table 3.2.) in Saracevic's (1996) manifestations of relevance. If the document was judged relevant and very useful, then it could be an indication of validity of this manifestation of relevance. On the other hand, if it was perceived as being not useful in this regard, then analysis should focus on what basis it was used. Investigation of this issue could throw more light on the cognitive process involved in relevance judgements, and the relative importance of the other proposed manifestations of relevance. This can only be done if the responses in total are analysed.

Question 4: How important was this document in the formulation of the focus of your research problem?

In the same way as above, if the respondent indicates in Question 4 that the document was not really important for the formulation of research problem, but it was still judged relevant to use, it provides a basis for examining the function of the document. This may lead to the identification of the other aspects influencing the relevance judgement (obviously this will be based on all other responses regarding used and not used documents).

The categorization of the degrees of relevance is "very useful", "fairly useful" and "not really useful". This is similar to the categorization used in the INEX (2002) (Initiative for the Evaluation of XML Retrieval) relevance assessment guide ("marginally relevant", "fairly relevant" and "highly relevant"). The option for totally "irrelevant" was not included in this question, since it was assumed that if the document was used to such an extent that it was included in the bibliography, it would at least have some degree of relevance to the work task.

Question 5: In what way was the document useful to you?

This question deals mostly with the satisfaction of the information need. To a lesser extent, it also serves a check for questions 2, 3 and 4. Analyses of responses to this question will indicate the validity of cognitive relevance (1, 7,

11, 28, 29), situational relevance relating to usefulness in terms of problem solving (8) and socio-cognitive relevance relating to viewpoint congruence (26) within the field of research. This question tries to show the importance of novelty in relevance judgements, as well as to provide an indication of the relation between the information need and the information object.

Question 6: Scope of the document in terms of research

This question is a three point scale trying to establish the specificity of the document in relation to the work task. This is measured by the usefulness, in terms of sufficient detail or depth (2), for the work task to be performed.

Question 7: How would you rate the expertise of the author?

This question relates to the perception of the subject knowledge of the author or creator of the information object. A four point scale ranging from "expert knowledge" to "very little knowledge" was used. The question regarding (the perception of) the author's knowledge may be seen as either a judgement of situational (16) relevance (acceptability in terms of the work task) or socio-cognitive (17) relevance (acceptability in terms of the socio-organizational environment in which the work task originated).

Question 8: How do you feel about the viewpoint of the author as expressed in the document?

The intention of this question is to find out to what extent the author's point of view agrees with the user's point of view in terms of the work task to be performed. This is a four point scale measurement of cognitive relevance in terms of viewpoint congruence (28).

Question 9: Relating to the author of the information object

This question tries to establish the relationship between the user and the author of the information object. The options and related relevance characterization is as follows:

"I am familiar with the author's work" (25): this option is an indication of socio-organizational acceptability of the author.

"I know the author personally" (24): an affective or emotional response, like or dislike of the author, or an indication of a personal or professional relationship with the author.

"I have used the author's work before in my research" (16, 17): an indication of the author's expertise, both in terms of the user's work task and the acceptability of the author within a particular socio-organizational domain.

"I will consider using this author's work again in future" (28): this option may be seen as an indication of a viewpoint congruence between the author and the user, measured in terms of cognitive relevance.

Question 10: The viewpoint of this document will be viewed favourably by my peers

This question requires a yes/no answer. If the answer is affirmative, it is an indication that the document will be well received within a particular socio-organizational domain, and is consistent with or supported by other information in the field (26).

Question 11: The academic standard of this document will be viewed favourably by my peers

This question also requires a yes/no answer, but differs from the previous question in the sense that the quality of the document is judged within a particular socio-organizational domain, rather than the point of view expressed in the document. If the answer is affirmative, it will indicate acceptability within a socio-cognitive relevance type (23).

Question 12: This document conforms to my own academic standards

In this question, the quality of the document is judged, once again on a binary level as in the previous question. In this case, however, it is not judged within a particular domain, but on the personal level of the user of the document. The document is regarded within the context of usefulness in terms of

reliability and standards of quality within a particular work task or situation (21).

Question 13: I agree with the viewpoint of the document

This question is the personal version of Question 10. The user is asked to judge the viewpoint of the document, but this time on a personal level – does the respondent as individual agree with the viewpoint of the document? This may be interpreted that the information need is addressed due to the fact that the document supports the current state of the user's knowledge (28).

Questions 14-16: Did you ask any other person's opinion about the information content of this document? If "yes", did this person influence your opinion of the document, and if "yes" again, in what way were you influenced?

The first question in isolation does not refer to any particular relevance judgement, but if the respondent answered "yes" to this question, he had to indicate in Question 15 whether this person's opinion had an influence on the respondent's view of the document. If the answer was affirmative again, the respondent was given an option in Question 16 to describe in what way he was influenced. The assumption is that the reasons given in the open-ended Question 16 may relate to any of the subjective relevance types.

Question 17: Relating to the terminology used in the document

This question tries to establish the user's responses to the terminology used in the document. The options and related relevance characterization is as follows:

"The terminology is known to me" (7): if the terminology is known to the respondent, it may be an indication that the information was perceived to be presented in a manner clear enough to satisfy the information need.

"The terminology was not known to me before I read this document" (7): if the terminology was not known to the respondent prior to reading the document, it may be an indication that the information has a novelty value, but it may also

indicate that the user found the information not presented clear enough to satisfy the information need. Both interpretations leads to a cognitive relevance judgement.

"The terminology is similar to the terminology used in other documents in the field" (19): if the terminology is in accordance with other documents in the field, it may be interpreted that there is a socio-organizational acceptance of the information object related to a particular work task.

"I use the same terminology" (28): if the respondent indicates that he uses the same terminology, it may be seen as supporting the user's current state of knowledge in terms of satisfying the information need.

"I will consider using terminology introduced by this document in future (28, 29)": this may be interpreted that the user already used the terminology and will continue to use it in future, but it might also mean that new terminology was introduced and that the user has learnt something new. In this case the information need is addressed in that the current state of knowledge was enhanced.

Questions 18-22: Font type, font size, layout, colours and writing style of the document

In answer to these five questions respondents were offered the choice of selecting either "was easy to read" or "irritated or frustrated me". These are all typical affective relevance judgements relating to the presentation or format of the information object (20).

Question 23: How important would you rate this particular document for your work task?

This question relates to the usefulness in terms of the work task and on a secondary level is also a built-in check question relating to Questions 3 (usefulness) and 4 (importance in terms of focus of research problem). The respondents were given the task of rating the importance of the document in the completion of the research project on a three point scale.

Question 24: At what stage in your research did you decide that this document might be useful?

The purpose of this question is to establish when the document was judged as relevant – during the search task, or during the work task performance. If the respondents selected the option "When I started my literature review" it is coded as *search task*. If any of the other three options were selected ("When I started writing the paper", "Halfway through the writing process" or "After I changed the focus of my paper"), it is coded as *work task*.

4.3.3. Section C: documents retrieved and read, but not used

Section C consisted of 25 questions to be answered for each document retrieved, obtained and at least partially read, but not used to such an extent that they were cited in the bibliography of the respondent's research project. Where it was assumed for Section B of the questionnaire that the entire document was read, in Section C respondents had to indicate how much of the document was read before it was decided that the document is not relevant. The aim of this section of the questionnaire was to determine why users reject some documents, even though some of the documents might be useful up to a certain point. Each of the questions will be discussed below in order to indicate the function of the question in the questionnaire. Where applicable, numbers in brackets refer to the numbers in the cells (relevance criteria within relevance types) in Table 4.4. Please note that some of the questions in Section C are exactly the same as in Section B. In these cases, the descriptions from Section B are repeated for the benefit of the reader.

Question 1: Bibliographic details of the document

The first question recorded the bibliographic information for each of the documents retrieved, but not cited. As in Section B, respondents had to either write the full bibliographic details of the information object used, or attach a copy of the bibliography to Section A and cross reference the records to Section C of the questionnaire.

Question 2: How much of the document did you read before you decided that it was probably not useful?

This question tries to establish whether the user had made a decision about the usefulness of a document based on metadata only, parts of the document or the entire document. Relating the answers to this question to the answers supplied in question 3a and 3b (usefulness of document), might give an indication of the cognitive state of the user at various stages of the information seeking process. If only the title, keyword and abstract were read, the respondent could make inferences regarding the "aboutness" of the document. This guides analysis of responses towards topicality and its manifestations in relevance judgements. On the other hand, if some parts or the entire document were read, the issues of topicality as well as issues pertaining to the situation, socio-cognitive context, affection and cognition come into play.

Question 3: All the documents in this section was not cited. However, some of them might have been useful to a certain degree. If the document was useful, but it was not cited, please answer 3a and 3b. If you read the document or parts of the document and it was not useful at all, please answer 3b only.

Question 3a makes provision for the case stated above where the document was not potentially used but could still have been useful, perhaps it has satisfied an information need (e.g. for background information) or helped in providing focus for the work task. Knowing how the document was useful is necessary to separate responses about documents that were actually still judged relevant and documents that were not judged relevant. This categorization of documents is necessary for a comparative analysis that should provide answers to the question on how and why users judge some documents relevant and others not. Question 3b is therefore necessary to reliably categorize documents in this way, and then once categories have

organizational domain, and is consistent with or supported by other information in the field (26).

Question 13: The academic standard of this document will be viewed favourably by my peers

This question also requires a yes/no answer, but differs from the previous question in the sense that the quality of the document is judged within a particular socio-organizational domain, rather than the point of view expressed in the document. If the answer is affirmative, it will indicate acceptability within a socio-cognitive relevance type (23).

Question 14: This document conforms to my own academic standards

In this question, the quality of the document is judged, once again on a binary level as in the previous question. In this case, however, it is not judged within a particular domain, but on the personal level of the user of the document. The document is regarded within the context of usefulness in terms of reliability and standards of quality within a particular work task or situation (21).

Question 15: I agree with the viewpoint of the document

This question is the personal version of Question 10. The user is asked to judge the viewpoint of the document, but this time on a personal level – does the respondent as individual agree with the viewpoint of the document? This may be interpreted that the information need is addressed due to the fact that the document supports the current state of the user's knowledge (28).

Questions 16-18: Did you ask any other person's opinion about the information content of this document? If "yes", did this person influence your opinion of the document, and if "yes" again, in what way were you influenced?

The first question in isolation does not refer to any particular relevance judgement, but if the respondent answered "yes" to this question, he had to

indicate in Question 17 whether this person's opinion had an influence on the respondent's view of the document. If the answer was affirmative again, the respondent was given an option in Question 18 to describe in what way he was influenced. The assumption is that the reasons given in the open-ended Question 18 may relate to any of the subjective relevance types.

Question 19: Relating to the terminology used in the document

This question tries to establish the user's responses to the terminology used in the document. The options and related relevance characterization is as follows:

"The terminology is known to me" (7): if the terminology is known to the respondent, it may be an indication that the information was perceived to be presented in a manner clear enough to satisfy the information need.

"The terminology was not known to me before I read this document" (7): if the terminology was not known to the respondent prior to reading the document, it may be an indication that the information has a novelty value, but it may also indicate that the user found the information not presented clear enough to satisfy the information need. Both interpretations leads to a cognitive relevance judgement.

"The terminology is similar to the terminology used in other documents in the field" (19): if the terminology is in accordance with other documents in the field, it may be interpreted that there is a socio-organizational acceptance of the information object related to a particular work task.

"I use the same terminology" (28): if the respondent indicates that he uses the same terminology, it may be seen as supporting the user's current state of knowledge in terms of satisfying the information need.

"I will consider using terminology introduced by this document in future (28, 29)": this may be interpreted that the user already used the terminology and will continue to use it in future, but it might also mean that new terminology was introduced and that the user has learnt something new. In this case the information need is addressed in that the current state of knowledge was enhanced.

Questions 20-24: Font type, font size, layout, colours and writing style of the document

In answer to these five questions respondents were offered the choice of selecting either "was easy to read" or "irritated or frustrated me". These are all typical affective relevance judgements relating to the presentation or format of the information object (20).

Question 25: At what stage of your research did you decide that this document might not be useful?

The purpose of this question is to establish when the document was judged as not relevant – during the search task, or during the work task performance. If the respondents selected the option "When I started my literature review" it is coded as *search task*. If any of the other three options were selected ("When I started writing the paper", "Halfway through the writing process" or "After I changed the focus of my paper"), it is coded as *work task*.

The discussion provided above is intended as a sufficient explanation of the questionnaire for the purposes of this study. There exists a wide range of possible responses and it is impossible to capture all of it in this thesis. It should, however, provide an indication of the following:

- The rationale behind the questionnaire construction;
- The measures of internal validity and reliability built into the design;
- The interrelatedness of the questions; and
- The aim of the questionnaire and its relation to the theoretical assumptions and the research questions.

4.4. Sample design and sampling methods

Due to the relative small size of the possible population, stratified purposive sampling (Patton, 1990) was done in order to illustrate characteristics of particular subgroups of interest and facilitate comparisons. The sample consisted of 33 respondents, answering questions regarding 467 documents

in total. There were four work tasks represented: masters and doctoral theses, class assignments, journal articles and conference papers. The latter two were later collapsed to one type of work task for statistical analysis as they were deemed the same (type of) work task. These particular work tasks were chosen, because it represents a spectrum of research activities – undergraduate, advanced and expert research. The complete table is represented below, and a summary table is presented in Section 5.1. in the next chapter.

Table 4.5. Questionnaires completed

Respondent number	Work task	Number of documents evaluated
1	Doctoral thesis	24
2	Doctoral thesis	15
3	Doctoral thesis	16
4	Conference paper	14
5	Doctoral thesis	16
6	Masters dissertation	26
7	Masters dissertation	19
8	Journal article	27
9	Conference paper	18
10	Doctoral thesis	22
11	Masters dissertation	30
12	Conference paper	10
13	Doctoral thesis	30
14	Masters dissertation	7
15	Doctoral thesis	18
16	Journal article	26
17	Masters dissertation	19
18	Class assignment	6
19	Class assignment	6
20	Class assignment	6
21	Class assignment	6
22	Class assignment	6
23	Class assignment	6
24	Class assignment	6
25	Class assignment	6
26	Class assignment	6
27	Class assignment	6
28	Class assignment	6
29	Class assignment	6
30	Class assignment	6
31	Class assignment	6
32	Class assignment	6
33	Masters dissertation	40
	Total	467

The inclusion of different work tasks were necessary, as part of the research design was to compare relevance judgements within work task domains. All the respondents were performing research within the field of information technology, mostly within information science and informatics. All respondents came from a research domain, as the introduction of commercial domains would have resulted in too many variables. The subjects were chosen on the grounds that they have just finished their research project. This was necessary because it was important that all the subjects had to be at the same stage of information use in their work task. This issue will be discussed in more detail in Chapter 5.

Due to the length of the questionnaire, it was explained to the respondents beforehand that it would take at least 2 hours of their time to complete the questionnaires. Respondents were given two weeks to complete the questionnaires. Participation was completely voluntary and respondents were not paid for participating in the research. All the participants who indicated that they were willing to participate, completed some questionnaires – detail of figures are summarised in Table 4.5. Undergraduate students had to, as part of their assignment, use at least six sources, and this is the reason for the uniformity of the number of sources used for the class assignments.

4.5. Data collection methods

Data were collected through structured self-administered questionnaires. For detail on the process of constructing these questionnaires, see Section 4.2 above.

The questionnaires were pre-tested on a group of second year information science students. Their work task consisted of a class assignment: writing a research essay on pre-defined topics over a period of six weeks. After the pre-test, some questions were rephrased, since some students noted that these questions were vague, but in general, not many changes were necessary.

4.6. Data capturing and data editing

The questionnaires (except for Section A) were pre-coded as far as possible according to the codes as listed in Table 4.4. (See also Sections B and C of the questionnaires in Appendix A). Post-coding of the open-ended questions was also done according to the criteria listed in Table 4.4. Completed questionnaires were marked up by the researcher herself and then the data were entered into the system by the data typists of Statomet at the University of Pretoria. Control lists were checked by the researcher and all anomalies noted and corrected. There were no significant problems regarding missing values.

4.7. Data analysis

Some of the research questions are theoretical assumptions that have been supported in Chapter 3 above, while other research questions are to be supported by empirical evidence. The research questions, assumptions and hypotheses are discussed individually in the next chapter. The SAS statistical package was used for data analysis.

4.8. Limitations of the methodology

The length of questionnaires are seen as the most problematic area in this study. To overcome this potential problem, a number of "check questions" were built into the questionnaire to establish whether the respondents are consistent in their answers.

Another limitation is that the sample was drawn from one discipline, that of information technology. It is feasible that information behaviour or users are not the same in all scientific disciplines and that relevance judgements may be made in other ways in sciences viewed as "harder" or "softer" than information technology. However, since the aim of this study is not to ascribe relevance judgements to users and seekers of information, but merely to establish the

validity of a model to study relevance types, this is not seen as a serious problem.

4.9. Summary

In Chapter 3 a model was defined which describes relevance in terms of relations between the stages of the information seeking and retrieval process on the one hand and the information objects on the other. In Chapter 4 the research methodology used to test various aspects of the model empirically has been described. In this chapter, the questionnaire construction, the rationale behind each question used in the questionnaire and the coding systems used for data analysis have been explained. The sample design and data collection methods have been described and the possible limitations of the methodology have been indicated. In Chapter 5, the results of the empirical study are presented and discussed.

CHAPTER 5: PRESENTATION AND DISCUSSION OF RESULTS

The aim of this research was to develop a model according to which relevance types in the information seeking and retrieval process may be "mapped". This "mapping" has been described in terms of various relations between the information objects on the one hand, and specific phases of the seeking and retrieval process on the other. The Ingwersen model of cognitive information transfer (Ingwersen, 1996) was assumed to be a valid construct to describe the elements and processes involved during information transfer. This model (as described in Chapter 3) formed the basis of a new relevance model, indicating the relationships involved in various relevance types.

The questionnaire which was developed as a tool to validate some of the aspects of the model has been described in Chapter 4. The purpose of the questionnaire was not only to provide data for this thesis but also to identify aspects of the subject for future research.

A detailed description of the results of the data gathered through the questionnaires in order to answer the research questions posed in Chapter 1 is provided in this chapter. In the first section of this chapter the sample profile has been summarised, and in the second part the results have been discussed for each research question individually. It should be noted that some of the questions are purely theoretical and have been discussed as such. When other questions have had to be supported by empirical evidence, appropriate tables and graphs have been used to describe the findings.

5.1. Sample profiles

The sample consisted of 33 respondents, who answered questions related to 467 documents in total. Initially there were four work task types represented. These were later reduced to three for statistical analysis as conference

papers and journal articles were deemed the same type of work task. The detail of the breakdown of the questionnaires is presented in Table 5.1.

Table 5.1. Summary of survey sample

Work tasks	Number of respondents	Number of documents evaluated		
		Section B: Relevant	Section C: Non-relevant	Total
Class assignments (undergraduate)	15	45	45	**90**
Conference papers and journal articles	5	95	19	**114**
Masters dissertations or doctoral theses	13	180	83	**263**
Total	**33**	**320**	**147**	**467**

All the respondents were undertaking research within the field of information technology, mostly within information science and informatics. They were chosen on the grounds that they have just finished their research project. This was necessary because it was important that all the researchers had to be at the same stage of information use in their work task. See also the discussion of the sample design in Section 4.4.

Most research projects studying the relevance judgements of users are longitudinal studies (Barry & Schamber, 1998; Borlund, 2000; Choi & Rasmussen, 2001; Fitzgerald & Galloway, 2001; Maglaughlin & Sonnenwald, 2002; Spink & Greisdorf, 2001; Vakkari & Hakala, 2000, etc.). This is an important approach, as it is well known that users' relevance criteria change as cognition regarding the work and search tasks changes.

In this empirical study, however, the final stage of information seeking and use were chosen (once the work task has been completed), because it is only at this stage of the process that users are able to state clearly which documents were sufficiently relevant to be used and cited, and which could be discarded (*even though they might have been useful to a certain extent at some stage during the work task execution*). For example, if the work task was not yet

completed, it may seem that a particular document was judged during use, but if that act leads to another iteration of searching and the document is not cited, then it was judged during the search task execution. It is therefore only at the end of the work task execution process that users are able to decide whether the information objects were judged during the work task as well as the search task execution, and whether the document was relevant enough to cite in their research.

5.2. Research questions: Data analysis and results

In this section, the main research question as well as the sub-questions have been discussed individually. Some of these are theoretical assumptions while other research questions had to be supported by empirical evidence. For the latter, as well as for questions combining theoretical and empirical aspects, complementary tables and graphs have been used to describe the findings.

In this chapter, reference is made to various "questions", namely the questions in the questionnaire, the main research question and derived questions, as well as the sub-questions as stated in Chapter 1. For clarity these are designated as:

- Questions from the questionnaire are shown in italics, for example, *Question 2.*
- The main research question is indicated as MQ and the two questions derived from the main research question as MQ_{D1} and MQ_{D2}.
- The sub-questions are shown as SQ_1 to SQ_6.

5.2.1. The main research question

The main research question (MQ) is:

How useful, in terms of understanding relevance, is it to define relevance types in terms of relations between elements in the process of information transfer?

This is regarded as mainly a theoretical question. The mapping of the relevance types as relations between elements in the process of information transfer depends on the definitions of the elements as well as the definitions of the relations. These definitions cannot be arbitrarily assigned, they have to, at least, be in accordance with other definitions in the field. These relations are those that have been mapped in Figure 3.3 and described in Sections 3.4 and 3.6.

The most contentious issues regarding this model where it was presented at conferences, doctoral workshops and publication (Cosijn & Ingwersen, 2000) were the following:

a) Are the relevance judgements made on grounds of *topicality* different from cognitive, situational and socio-cognitive evaluation? (MQ_{D1})

b) Can socio-cognitive relevance be seen as a category of relevance judgement separate to those of cognitive and situational? (MQ_{D2})

Although the main thrust of this question was regarded as a theoretical exercise, these two issues were supported by using empirical evidence.

The second question (MQ_{D2} – dealing with socio-cognitive relevance) has been discussed under sub-question 6 (SQ_6) in this chapter, where it was shown that the notion of socio-cognitive relevance does exist as a separate relevance category.

The first of these questions stated above (MQ_{D2} – dealing with the issue of topical relevance), was addressed by cross-tabulation of Variable 6 (V6 in *Question 2* of Section B), a purely topical relevance judgement, with other possible relevance judgements about the same document. It was assumed that if a respondent indicated that the document was used because it was topically relevant (chose V6 as an option), but also listed other types of relevance which (by definition) do not necessarily involve topicality, it shows that topicality does not preclude other levels of relevance judgements.

Of the total of 320 documents which were judged relevant, 138 were judged relevant on grounds of topicality (V6 was selected). These 138 documents were also in turn judged relevant for other reasons, as indicated by the respondents in *Question 2* (reasons for use) and *Question 5* (reasons for usefulness) in Section B of the questionnaire. The result of this was that in addition to topicality (V6), there were 391 other options selected in *Question 2* and a total of 120 in Question 5.

Tables 5.2 and 5.3 show the distribution of other relevance judgements made in *Question 2* and *Question 5* respectively. These were then sorted by relevance type (as defined in Chapter 3) and subtotals calculated for each of the relevance types.

It should be noted that the descriptions of the reasons for use (Table 5.2) or usefulness (Table 5.3) are not necessarily the same as those found on the questionnaire. The descriptions used in the tables have been standardised according to the pre-coded value in terms of Table 4.3. It should also be noted that *Question 2* offered scope for own reasons (open questions) which were post-coded, and these were included in the analysis below.

The first row entry in Table 5.2 is labelled "uncategorized" as it is not clear whether the fact that the respondent was familiar with the work of the author constitutes an affective relevance judgement or a cognitive relevance judgement. The option was originally included as an affective relevance judgement when the questionnaire was constructed, but without cross-tabulation with *Question 9* it is not clear whether the respondent has an *affective* relationship with the author. In this table, the value was therefore not included in calculations by relevance type.

Table 5.2. Analysis of topical relevance judgements together with other subjective relevance types in terms of reasons for use – Question 2

Reasons for use (Question 2)	Relevance type	N	%
Familiar with work of author	Uncategorized	75	19.18
Emotional response with regard to viewpoint congruence	Affective	2	0.51
Background information	Cognitive	5	1.28
Real needs in terms of hard data, facts, figures	Cognitive	14	3.58
Supports current state of knowledge	Cognitive	182	46.55
Enhances current state of knowledge	Cognitive	1	0.26
Sub-total for cognitive relevance		**202**	**51.67**
Hard data etc. required in work task situation	Situational	1	0.26
Sufficient detail/depth	Situational	4	1.02
Accessible/available within work task	Situational	42	10.74
Current/recent in terms of work task	Situational	1	0.26
Author's expertise in terms of work task	Situational	1	0.26
Usefulness of format in work task	Situational	6	1.53
Sub-total for situational relevance		**55**	**14.07**
Acceptable within domain	Socio-cognitive	18	4.59
Author's expertise in terms of domain	Socio-cognitive	2	0.51
Presentation/format acceptable in domain	Socio-cognitive	3	0.77
Socio-organizational acceptability on terms of quality	Socio-cognitive	3	0.77
Consistent or supported by others in domain	Socio-cognitive	31	7.93
Sub-total for socio-cognitive relevance		**57**	**14.57**
	Total	**391**	**100.00**

Table 5.3. Analysis of topical relevance judgements together with other subjective relevance types in terms of reasons for use – Question 5

Reasons for use (Question 5)	Relevance type	% N=120
Background information	Cognitive	23.33
Clarity in terms of information need	Cognitive	2.50
Real needs in terms of hard data, facts, figures	Cognitive	21.67
Supports current state of knowledge	Cognitive	15.83
Enhances current state of knowledge	Cognitive	16.67
Sub-total for cognitive relevance		**80.00**
Problem solving within research focus	Situational	10.00
Sub-total for situational relevance		**10.00**
Consistent of with or supported by others in the field	Socio-cognitive	10.00
Sub-total for socio-cognitive relevance		**10.00**
	Total	**100.00**

As can be observed from the tables, there is a significant distribution of relevance categories that were chosen in conjunction with topicality. It has to be borne in mind that multiple options could be selected and *Question 2* also included open-ended questions. The percentages by relevance category were calculated only for the sake of interest and should not be interpreted as an indication of which relevance category was chosen by most respondents.

The sub-questions (SQ) related to and derived from the main question (MQ) have been analysed in detail below. This has included their classification as either a theoretical or an empirical question.

5.2.2. Sub-question 1

Is this categorization of relevances as typified in the model a viable way of typifying relevance types? (SQ_1)

This first sub-question is viewed as a purely theoretical question. The matter of the viability of the modelling process is seen to be more objectively judged if it is compared with accepted research performed by other people, instead of

being forced into a new model. The research used was that of Barry and Schamber (1994) and Vakkari and Hakala (2000) as discussed in Section 3.9 of this study. It was found that if the relevance types as identified in Section 3.6 were retrospectively mapped back to this empirical work done previously, the model as depicted in Figure 3.3 is a viable way of typifying relevance types.

The further empirical testing of various aspects of the model as reported in this chapter, has confirmed the viability of this model.

5.2.3. Sub-question 2

Does the nature of the work task influence the application or non-application of documents in work task fulfilment? (SQ_2)

Essentially, this also queries whether the profiles of relevance judgements made within different work task environments vary.

This sub-question is viewed as an empirical question. In this empirical study, three different work tasks were identified:

- the writing of masters or doctoral theses (Variable V1 was coded as 1 in Sections B and C of the questionnaire),
- the writing of conference papers or journal articles (V1 was coded as 2 or 3 in Sections B and C of the questionnaire), and
- the writing of essays as a class assignment (V1 was coded as 4 in Sections B and C of the questionnaire).

See Table 5.1 for details about the numbers of relevant and non-relevant documents judged.

In order to answer this sub-question, the different codes for V1 (work task, as described above) were cross-tabulated with variables V5 - V10 in *Question 2* (reasons for using the documents), as well as with variables V16 - V24 in *Question 5* (reasons for usefulness of the documents). The assumption was that if the work tasks were compared in terms of the relevance judgements

made, it would be possible to establish whether the nature of the work task has an influence on the way that relevance judgements are made, and specifically on the type of relevance judgements made.

A summary of this data is presented in Table 5.4. The number of documents judged relevant by masters and doctoral students ($N_{M,D}$) was 180, by authors writing conference papers or journal articles ($N_{P,A}$) was 95 and by undergraduate students writing class assignments (N_{CA}) was 45. N_{Vx} in the second column refers to the number of documents judged relevant according to the variables (V) in *Questions 2* and *5* respectively, where x is the number assigned to the variable. Please note that the columns in the table do not necessarily add up to 100%, due to the fact that respondents could select multiple options.

A sufficient number of respondents selected each of the variables in *Questions 2* and *5* in order to make it possible to perform tests of statistical significance. For this particular research question, the limitations and assumptions for the chi-square test were met.

The null- and alternative hypotheses were therefore stated as follows:

- H_o: There is no relationship between the relevance types and the work task environments.
- H_a: The relevance judgements differ by work task environment.

The p-value for the chi-square test was set at 0.05 as is standard for two-tailed tests (Hernon, 1994). Note that the percentage values in the columns of Table 5.4 should be interpreted as not only the value listed, but also that the complement of the value (difference between the value and 100%) is implied. As can be observed from the chi-square test p-values in Table 5.4 (set at $p<0.05$), as well as the representation of the data contained in Figure 5.1, there are significant differences in the type of relevance judgements made within various work task situations. The null-hypothesis was therefore

rejected in most cases and it was concluded that there is a relationship between some of the relevance judgements within different work task domains. These differences have been discussed in detail by variable below.

For the sake of completeness, a more detailed table is presented in Appendix C, where the degree of relevance was also taken into account. In this case, the data in Table 5.4 were also analysed by the degree of usefulness, as indicated by Variable 14. However, the introduction of this further breakdown of the data had the result that the size of the some of the individual cells were too small to do any tests of statistical significance.

Appendix D contains a table of relevance types by work task, summarising the detailed information given in Tables 5.3 and 5.4, as well as a graphic representation of the aforementioned table.

Table 5.4. Reasons for use/usefulness of document by work task

Question	Variable(V)	Reasons for use/usefulness	Masters and Doctoral theses N_{MD}=180	Confe-rence papers and journal articles N_{PA}=95	Class assign-ments N_{CA}=45	X^2-test p-value
Question 2 (Reasons for use)	5	Retrieval engine gave it a high relevance ranking N_{V5}=94	32.22	18.95	40.00	0.0172*
	6	The topic of the document is very similar to the topic of my paper N_{V6}=138	44.44	36.84	51.11	0.2433
	7	The viewpoint of this document supports my approach to the topic N_{V7}=182	55.00	58.95	57.78	0.8082
	8	The viewpoint of this document is in accordance with the approach of the conference theme N_{V8}=31	1.67	11.58	33.33	<0.0001*
	9	It was easy to obtain / I couldn't find anything else N_{V9}=42	16.11	5.26	17.78	0.0246*
	10	I know the work of this author N_{V10}=70	18.89	33.68	8.89	0.0014*
Question 5 (Reasons for usefulness)	16	It provided me with background information N_{V16}=204	62.22	63.16	71.11	0.5349
	17	It provided me with detailed information N_{V17}=152	47.22	41.05	62.22	0.0639
	18	It told me something I did not know N_{V18}=145	43.89	35.79	71.11	0.0004*
	19	It verified something I already knew N_{V19}=135	41.67	46.32	35.56	0.4735
	20	It changed the focus of my paper N_{V20}=18	3.89	3.16	17.78	0.0007*
	21	It helped me to solve a problem N_{V21}=80	24.44	15.79	46.67	0.0004*
	22	It helped me to make a decision N_{V22}=81	30.56	6.32	44.44	<0.0001*
	23	It is meaningful within the theme of the conference N_{V23}=38	2.78	22.11	26.67	<0.0001*
	24	The viewpoint of this document has an interesting/unusual perspective on the conference theme N_{V24}=20	5.00	6.32	11.11	0.3173

* Values marked with an asterisk in the right hand column indicate that differences in terms of work task are statistically significant

Figure 5.1 below is a graphical representation of Table 5.4.

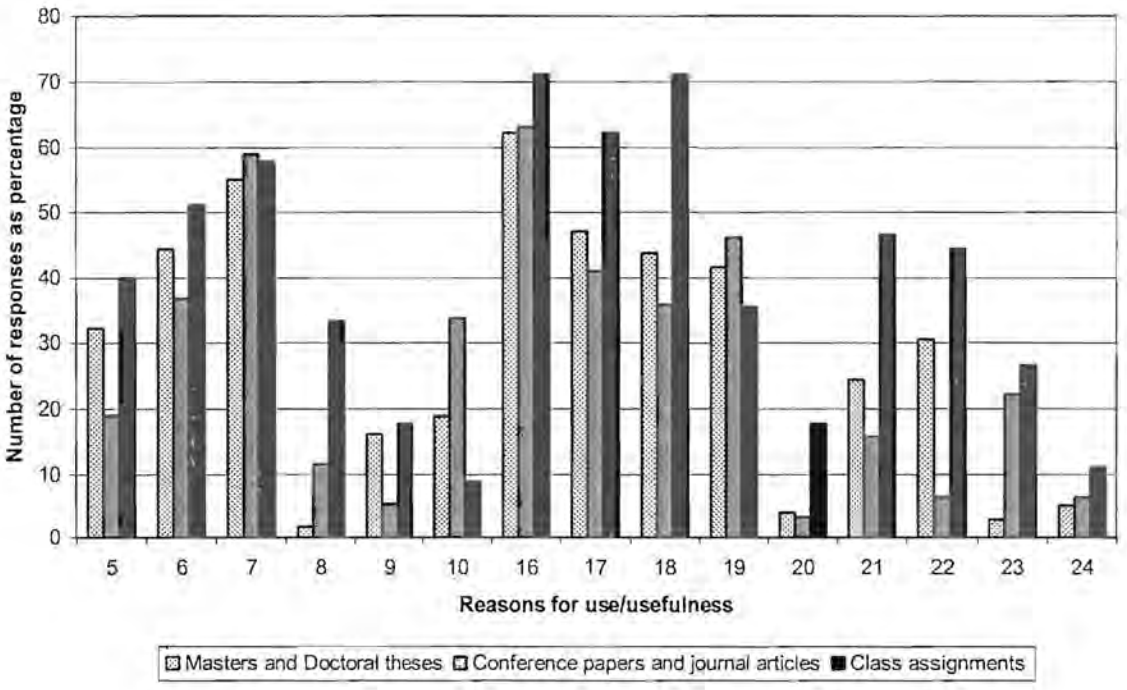

Figure 5.1. Reasons for use/usefulness by work task

The chart above (Figure 5.1) shows the distribution of the relevance types, with the values on the X-axis referring to the reasons for use/usefulness as listed in the preceding table.

In discussing the variations by work task for each of the variables (V) below, *possible* explanations for the significant differences have been presented. These should by no means be viewed as the only definite and final answers to the questions posed, but also as providing indicators for possible further research. The number in brackets after the "V" option title refers to the value of the relevance judgement as indicated in Table 4.3. Percentages have been rounded to the nearest whole number, in order to facilitate readability.

- *V5. The retrieval engine gave it a high relevance ranking (30)*

This is a purely algorithmic relevance type, there is no subjective user evaluation present. 40% of the documents used by undergraduates, 32% of documents used by masters and doctoral students and only 19% of

documents used by respondents who were writing either a journal article or a conference paper indicated this as one of the reasons that a particular document was used.

The question, as it was phrased in the questionnaire could have been misleading, as it might have been perceived to be valid only if the document was found on the Web, or if a search engine was used. This particular variable was therefore not used in any calculations, and where it has been used in a representation of the distribution of data, it should not be interpreted as being indicative of algorithmic relevance judgements as interpreted by users in general.

A possible reason for the statistically significant differences between the different work tasks with regards to this type of relevance judgement is that the actual state of knowledge of the undergraduate students is relatively incomplete, and therefore they cannot make an informed decision about the value of a document to the work task. They therefore rely on search engines to indicate which of the documents have higher relevance to their queries.

Similarly, masters and doctoral students are expected to read "everything" on their topic in order to conduct a complete literature review. As their actual state of knowledge may also incomplete at the first stages of the work task, they rely on the algorithmic evaluations of the search engine to yield the largest number of highly relevant documents.

The actual state of knowledge of persons writing articles for journals of conference papers are typically more complete than for the other two work tasks, and searching is usually much more focussed. These persons therefore do not have to rely on search engine evaluation as much as the others.

- *V6. The topic of the document is very similar to the topic of my paper/thesis (31)*

This is a topical relevance judgement and is partly reliant on algorithmic matching of the document and partly on user evaluation of the document. 44% of the papers evaluated by masters and doctoral students, 51% of papers evaluated by undergraduates and 37% of papers evaluated by authors of papers or articles indicated that this was one of the reasons for using a particular document.

The actual state of knowledge of the users could possibly, once again, be seen as a reason for the difference (though not statistically significant) between the undergraduate students and the authors of papers in this case. The undergraduates have a relatively low level of knowledge regarding a topic, whereas authors of papers and articles are generally experts in their field. Their ability to integrate past knowledge with current information is therefore much higher than that of the undergraduate students. Thus the aboutness of retrieved documents is probably not as important for the authors as it is for the undergraduates in making sense of the documents for application in the work task.

- *V7. The viewpoint of this document supports my approach to the topic (28)*

This is a cognitive relevance judgement, in that there is a viewpoint congruence with regards to the document and the information need of the user. There were no significant differences between the judgements of the three groups: 55% of the papers evaluated by doctoral and masters students, 59% of the papers evaluated by authors of papers or articles and 58% of the papers evaluated by undergraduates indicated that this was one of the reasons a particular document was used.

- *V8. The viewpoint of this document is in accordance with the approach of the conference theme/journal focus/degree course (26)*

This is regarded as a socio-cognitive relevance type as indicated in Table 3.7. There are quite major differences between the judgements made within the various work tasks with regards to this option. 33% of the papers evaluated by undergraduate students stated this option as one of the reasons why the document was regarded as relevant, while 12% of the papers evaluated by authors of papers and articles and only 2% of papers evaluated by masters and doctoral students stated this option.

A possible reason for this divergence is that undergraduates do not yet have the understanding of more experienced researchers to integrate different viewpoints into their own research, and may think that if the viewpoint of a document is in accordance with the course, then it should be relevant. Advanced students, however, are expected to read as widely as possible and then integrate and assimilate the information into a variety of categories. It is therefore acceptable, or even required to read different points of view and still regard these documents as relevant.

- *V9. It was easy to obtain/I couldn't find anything else (5)*

This relevance judgement relates to the accessibility and availability of documents and is a situational relevance judgement. For this option, there is also a very interesting distribution across the three different work task categories: 16% of the papers evaluated by masters and doctoral students stated this as one of the reasons for using a document, 18% of the papers evaluated by undergraduates and only 5% of the papers evaluated by authors of papers and articles.

A possible reason for this distribution is that authors of articles and conference papers have to be more circumspect in the type of documents they cite. There is a much larger element of social/organizational acceptance involved in the judgements of such papers. The motivational factors for searching for relevant documents may therefore be seen to be greater in the case of these authors. Furthermore, due to the length of such papers compared to a thesis.

there is not much latitude for unnecessary debate. On the other hand, with regards to theses, it is expected that students read as widely as possible and there is an element of pressure regarding the length of the bibliography as an indication of the completeness of the literature survey.

- *V10. I know the work of this author (24)*

This judgement related to the relationship of the user with the author of a document, whether personal or professional and is regarded here as an affective relevance judgement. One would expect that undergraduate students do not yet know the authors in the field and therefore would not often use this reason to use a document. This assumption was supported by the figures – only 9% of the documents evaluated by undergraduates stated this as one of the reasons why a document was used as opposed to 34% of documents evaluated by authors of papers and articles. 19% of documents evaluated by masters and doctoral students stated this as one of the reasons. This result accords with the assumption above – namely, the masters and doctoral students don't know the authors as well as the experts, but do so better than the undergraduate students.

- *V16. It provided me with background information (1)*

This is a cognitive relevance judgement. Of all the options in *Questions 2* and *5*, this option had the highest number of responses from all three categories of work task. 71% of the documents evaluated by undergraduate students, 62% of the documents evaluated by doctoral and masters students and 63% of the documents evaluated by authors of papers or articles stated this as one of the reasons why a document was regarded as useful. Although the numbers are not significantly different, the fact that more undergraduate students chose this option may be ascribed to their actual state of knowledge being less complete than in the other two groups, and that more documents would provide background information to these students than to the other groups where the actual state of knowledge is more complete.

- *V17. It provided me with detailed information (11)*

This is also regarded as a cognitive relevance judgement and related to the users' real needs with regard to proven information, hard data, facts or figures required for the successful execution of the work task. This distribution was found not to be statistically significant ($p>0.05$). 62% of the documents evaluated by undergraduate students, 47% of the documents evaluated by masters and doctoral students and 41% of the documents evaluated by authors of articles or papers stated this as one of the reasons why a document was regarded as useful. The relatively high percentage of undergraduates who chose this option might also possibly relate to the fact that their actual state of knowledge is relatively incomplete, as in the case stated for the previous option.

- *V18. It told me something I did not know (29)*

This is a cognitive relevance judgement and refers to an enhancement of the current state of knowledge. It might be expected that the figure would be substantially higher for undergraduates, since their actual state of knowledge is relatively incomplete, and this was supported by the figures: 71% of the documents evaluated by undergraduates stated this as one of the reasons for using a document, whereas only 36% of the papers evaluated by the authors of papers and articles stated this option. 44% of the documents evaluated by masters and doctoral students stated this as an option, thereby further supporting the assumption above relating to the current state of knowledge of the respondents.

- *V19. It verified something I already knew (28)*

This is a cognitive relevance judgement and related to the support of the current state of knowledge. Whereas the figure for the previous option (V18 – novelty value) was relatively high for the undergraduates, in this case it was just the opposite. 36% of the documents evaluated by undergraduates, 42% of the documents evaluated by the masters and doctoral students and 46% of the documents evaluated by the authors of papers or articles stated this as

one of the options. These statistics support the assumption stated under the previous option, namely that the current state of knowledge is incomplete for undergraduates, more complete for post graduates and most complete for experts. Therefore the respondents with the lowest level of knowledge will learn more from a document, and the respondents with the highest level of knowledge will learn less, but will have more of his knowledge supported. It should, however, be noted that the distribution proved not to be statistically significant.

- *V20. It changed the focus of my paper (8)*

This situational relevance judgement related to the usefulness of the document in terms of problem solving within the particular research focus. Of all the options in *Questions 2* and *5*, this one had the lowest response - only 18 responses over the entire population. Of these, 4% were documents evaluated by doctoral or masters students, 3% were documents evaluated by authors of papers or articles and 18% were documents evaluated by undergraduate students. The fact that only the only significant percentage comes from the undergraduate students might possibly also relate to their incomplete state of knowledge, and that it results in relatively unfocussed work tasks. If the work task is not clear in the user's mind, then it is more likely that the focus will change through use of information.

- *V21. It helped me solve a problem (8)*

This is also a situational relevance judgement, and lies in the same category as the previous option as indicated in Table 4.3. It related to the usefulness of the document in terms of problem solving within the particular research focus. For the assumption in the previous option (V20) to hold, the same relative percentage distribution would be expected over the different work tasks as above, and this was indeed found to be so. 47% of the documents evaluated by undergraduates, 24% of the documents evaluated by the postgraduate students and 18% of the documents evaluated by the authors of papers stated this option as one of the reasons for a document to be useful.

- *V22. It helped me make a decision (7)*

Whereas V20 and V21 related to the clarity of the document within the situation of the work task, this option related to the clarity of the document in terms of the personal (real) information need, and is therefore regarded as a cognitive relevance judgement. The relative percentage distribution across the work tasks are somewhat similar to the two cases above - 44% of the documents evaluated by undergraduates, 31% of the documents evaluated by post graduates and 6% of the documents evaluated by experts stated this as one of the reasons for the usefulness of a particular document. As in the previous cases, this also might be due to the current level of knowledge of the undergraduates being very low, higher in the case of the post graduate students and much higher in the case of the experts writing articles or papers.

- *V23. It is meaningful within the theme of the conference/journal focus/degree course (26)*

This is a socio-cognitive relevance judgement in the same category and therefore very similar to the question presented with Variable 8 above, and therefore one would expect the same relative percentages across the work tasks. Here once again, there are quite major differences between the judgements made within the various work tasks. The percentage distribution for the previous question (V8) have been listed in parenthesis next to the percentages for this question for easy comparison. 27% (33%) of the documents evaluated by undergraduate students stated this option as one of the reasons why the document was regarded as useful, while it was stated by 22% (12%) of the documents evaluated by authors of papers and articles and only 3% (2%) of documents evaluated by masters and doctoral students.

A possible reason for this distribution is again that undergraduates do not yet have the understanding of more experienced researchers to integrate different viewpoints into their own research, and may think that, if the viewpoint of a document is in accordance with the course, then it should be relevant.

Advanced students, however, are expected to read as widely as possible and then integrate and assimilate the information into a variety of categories. It is therefore acceptable, or even required to read different points of view and still regard these documents as relevant.

- *V24. The viewpoint of this document has an interesting/unusual perspective on the conference theme/journal focus/degree course (26)*

This is regarded as a socio-cognitive relevance judgement, but in the context of this question any response might be interpreted as a negative socio-cognitive relevance. In other words, it could be interpreted as "going against the grain" of what is regarded as acceptable. This option was chosen by relatively few respondents, only 20 documents over the entire population. Of these, 4 were documents evaluated by doctoral and masters students, 5 were documents evaluated by authors of articles or papers and 11 were documents evaluated by undergraduate students. Due to the ambiguity of the interpretation of the question, no possible reasons have been sought to explain the result. The data were also found not to be statistically significant. However, an interesting study at a later stage might be to establish what other relevance judgements were made by respondents who wrote conference papers or journal articles because, in this context, socio-organizational acceptability is an important issue.

The conclusion that may be drawn from the data sets related to this research question is that the null-hypothesis are rejected in most cases and that there is in fact a significant variation in the profiles of relevance judgements made within different work task environments. From the discussion above stating possible reasons for these differences in relevance judgements, it would seem that this is mainly due to the actual state of knowledge and the ability of the users to utilize the information within a particular work task situation. Socio-cognitive relevance judgements also seem to play quite an important role in the decision to use a document within a particular work task.

A table of relevance types by work task summarizing the detailed information given in Tables 5.3 and 5.4, as well as a graphic representation of this table are presented in Appendix D.

5.2.4. Sub-question 3

Are some relevance judgements made during the process of seeking for information (search task) while others are made while using information during the execution of the work task? (SQ_3)

In Section 3.8 the difference between search task execution and the use of information in work task performance was discussed. The model as derived in Chapter 3 also stresses the distinction between the two types of tasks. In order to establish whether there is in fact a difference between the types of relevance judgements made during the execution of the two tasks, empirical data gathered through the questionnaires were used. This sub-question is therefore also regarded as an empirical question.

In order to answer this sub-question the data used for statistical analysis were as follows:

For Section B (documents used) variables V5 - V13 in *Question 2* (reasons for use) have been combined with variables V16 - V24 in *Question 5* (reasons for usefulness) and cross tabulated with variable V51 (indicating whether the judgement was made during work task or search task). The variables were then linked with the relevance types as listed in Tables 4.3 and 4.4. The percentage of relevance judgements made within each relevance type were then calculated and compared for work task and search task execution respectively. The results are presented in Table 5.5 below.

Due to a typing error in *Question 25* of Section C (non-relevant documents) the data collected will not be represented here. The question should have read "At what stage of your research did you decide that this document might not be useful?" instead of "At what stage of your research did you decide that this document might be useful?"

The limitations and assumptions for the chi-square test were met for SQ_3. The null- and alternative hypotheses were therefore stated as follows:

- H_o: There is no relationship between the relevance categories and the task type.
- H_a: The distribution of the relevance categories differ in relation to task type.

Table 5.5 includes the frequency (actual number of responses) by relevance type. In Appendix E (Table E.1) all the detail, including the actual frequency by work task as well as expected frequency by relevance type and work task for comparison with the actual frequencies. Table E.1 also includes both raw percentages (number of documents as percentage of 529) and row percentages, although only the row percentages as indicated in Table 5.5 will be used in the interpretation of the results.

The p-value was set at 0.05, as is standard for two-tailed chi-square tests (Hernon, 1994). The calculated chi-square value was 10.4085 and $p=0.0341$. The null-hypothesis was rejected due to the fact that $p<0.05$ and it was therefore concluded that the observed differences in the distribution of the relevance categories in relation to task type is significant.

Table 5.5. Relevance judgements by task type - documents cited

Relevance Type	N	Search task	Work task	Total
Affective	77	63.64	36.36	**100.00**
Cognitive	202	62.87	37.13	**100.00**
Situational	55	43.64	56.36	**100.00**
Socio-cognitive	57	54.39	45.61	**100.00**
Topical	138	66.67	33.33	**100.00**
Total	**529**			

It may be observed from the row percentage data in Table 5.5 that the only percentage higher for the work task than for the search task, is that of situational relevance. All other types of relevance judgement were made more often during the search task execution than for the work task execution. From this it may be concluded that situational relevance is more strongly associated with work task performance, whereas topical, cognitive, socio-cognitive and affective relevance judgements are more strongly associated with search task execution.

5.2.5. Sub-question 4

To what extant are the identified relevance types "nested"? (SQ_4)

In other words, are certain relevance judgements by definition included within other types of relevance judgements?

From the stratified model of relevance types by Saracevic (1996) as well Borlund's studies (2000), it would seem that some authors in the field view relevance types as inherently "nested". It could be argued, for instance, that if an information object is judged as relevant on a cognitive level, it should also be relevant on a topical level. The assumption for this research question is that the relevance types as depicted in the model (Figure 3.3) are not necessarily nested.

In order to answer this sub-question, the data sets created were as follows:
It was assumed that if the respondent marked variable V5 (the search engine gave the document a high relevance ranking) in *Question 2* in Section B of the questionnaire, an *algorithmic relevance* judgement was made. However, 71% of the total sample did not select the option in *Question 2* that indicated that the document was algorithmically relevant. Since this was not a compulsory answer, it should not be concluded that documents are seldom algorithmically relevant. This value was therefore not included in the final calculations for this sub-question, as already explained in Section 5.2.3.

If the respondent selected V6 (the topic of the document is very similar to the topic of my paper), then it was assumed that a *topical relevance* judgement was made.

If the respondent selected any of the following, then it was assumed that a *cognitive relevance* judgement was made:

- V7 = 28 (supports current state of knowledge)
- V11 or V12 or V13 = 1 or 7 or 9 or 11 or 14 or 28 or 29 (these were open-ended questions which were post-coded according to Table 4.3. The values listed here signifies a cognitive relevance judgement)
- V16 = 1 (background or specific information need)
- V17 = 11 (real information needs – hard data, facts, figures)
- V18 = 29 (enhances current state of knowledge)
- V19 = 28 (supports current state of knowledge)
- V22 = 7 (clarity of presentation in terms of information need)

If the respondent selected any of the following, it was assumed that a *situational relevance* judgement was made:

- V9 = 5 (accessibility/availability)
- V11 or V12 or V13 = 2 or 3 or 5 or 8 or 10 or 12 or 15 or 16 or 18 or 21 (these were open-ended questions which were post-coded according to

Table 4.3. The values listed here signifies a situational relevance judgement)

- V20 or V21 = 8 (problem solving within research focus)

It was assumed that if a respondent selected either V32 or V33 (the acceptability of the viewpoint of the document or the quality of the document within the broader socio-organizational domain) then a *socio-cognitive relevance* judgement was made.

Table 5.6 below is a summary of the data of the cross-tabulation of the variables described above. Table 5.7 contains the same data as Table 5.6, but whereas the former is sorted by the number of occurrences within the various possibilities of nesting, the latter is a representation of the data showing the various possibilities of nesting, from a topically relevant perspective. A "Yes"-value in the cell is assumed to be a definite relevance judgement of the type indicated, whereas a hyphen, "-" is an indication that the box was not ticked when the questionnaire was completed.

Table 5.6. Nesting of relevance types by number of occurrences

Topical	Cognitive	Situational	Socio-cognitive	N	%
-	Yes	-	Yes	114	**35.65**
Yes	Yes	-	Yes	75	**23.44**
-	Yes	Yes	Yes	61	**19.06**
Yes	Yes	Yes	Yes	60	**18.75**
-	Yes	-	-	4	**1.25**
Yes	Yes	-	-	1	**0.31**
Yes	-	Yes	-	1	**0.31**
Yes	-	-	-	1	**0.31**
-	Yes	Yes	-	1	**0.31**
-	-	Yes	Yes	1	**0.31**
-	-	-	Yes	1	**0.31**
			Total	**320**	**100.01**

Table 5.7. Visualization of the nesting characteristics of relevance types according to empirical data

Topical		**Cognitive**		**Situational**		**Socio-cognitive**	
Yes	43.12	**Yes**	43.12	**Yes**	18.75	**Yes**	18.75
						-	0.00
				-	23.75	**Yes**	23.44
						-	0.31
		-	0.00	**Yes**	0.31	**Yes**	0.00
						-	0.31
				-	0.31	**Yes**	0.00
						-	0.31
-	56.87	**Yes**	56.25	**Yes**	19.37	**Yes**	19.06
						-	0.31
				-	36.88	**Yes**	35.63
						-	1.25
		-	0.62	**Yes**	0.31	**Yes**	0.31
						-	0.00
				-	0.31	**Yes**	0.31
						-	0.00
	99.99		**99.99**		**99.99**		**99.99**

From these tables it can be clearly seen that the relevance types are not nested, but due to the small sample size of some of the cases, tests of

statistical significance could not be performed. The statistical findings have therefore only been discussed within context.

39% (124) of the documents evaluated were considered to be situationally relevant. Of these only two documents were judged to be not socio-cognitively relevant. On the other hand, of the 61% (196) of the documents which were considered to be not situationally relevant, the majority (190) were considered to be socio-cognitively relevant.

99% of all documents used were considered to be cognitively relevant. This is a clear indication that the enhancement or support of the current cognitive state is an important factor when users judge the relevance of documents. Of these documents, 38% were also judged to be situationally relevant, while 61% were not considered such. Furthermore, of this 61% of the documents which were considered to be cognitively relevant, but not situationally relevant, 59% were also judged to be socio-cognitively relevant. It would therefore seem that the relationship between cognitive and socio-cognitive relevance is much stronger than the relationship between cognitive and situational relevance or between situational and socio-cognitive relevance. This area of the study requires further research.

Of the 99% of the documents which were deemed to be cognitively relevant, 43% were stated to be topically relevant. 56% did not indicate topical relevance as one of the reasons why the document was regarded as relevant. This should, however, not be interpreted that topicality is not an important relevance criteria, since this question was not a compulsory question.

The results of this study confirm that relevance types are not necessarily nested. There is a clear indication that both situational and topical relevance are independent from the other relevance types, as well as independent from each other. However, the data shows interesting relationships between the subjective relevance types of cognitive and socio-cognitive relevance and

these require further study. Section 5.2.7 attempts to address some of the aspects of the relationship between these two relevance types.

5.2.6. Sub-question 5

To what extent are affective relevance judgements made in conjunction with the other relevance types? (SQ_5)

In Section 3.6.6 affective relevance was described as the relation between the goals, intents and motivation of the user on the one hand, and the information object on the other. *Affective relevance should not be seen on the same scale as the other relevance types, but rather as another dimension that is assumed to have an influence on all the other relevance types*. See Figure 3.3.

Affective relevance are difficult to capture by means of a questionnaire and therefore, in order to answer this sub-question it was assumed that if any of the factors such as font size, font type, colours, layout or writing style of the document was evaluated *negatively* (*Questions 18-22* of Section B, the questionnaire dealing with relevant documents), then a definite affective relevance judgement was also considered to have been made. If all these factors were evaluated positively, it is debatable whether a *definite* affective relevance judgement was made, and was therefore not taken into account. Three new tables of data were generated, namely where all the affective relevance judgements made were cross-tabulated in Table 5.8 with reference to the reasons for use from *Question 2*, Table 5.9 with reference to reasons for usefulness from *Question 5* and Table 5.10 with reference to the terminology-related issues from *Question 17* of Section B of the questionnaire.

It was further assumed that if any of the factors such as font size, font type, colours, layout or writing style of the document was evaluated *negatively, even if the document was not used* (*Questions 20-24* of Section C, the questionnaire dealing with non-relevant documents), an affective relevance judgement was also considered to have been made. Another three tables of

data were generated, namely where the affective relevance judgements made were cross-tabulated in Table 5.11 with reference to the reason for usefulness (even if the document was not used) from *Question 3a*, in Table 5.12 with reference with reasons for non-use from *Question 3b* and Table 5.13 with reference to author-related issues form *Question 11* of Section C of the questionnaire.

The small sample sizes of some of the data sets precluded significance tests, but from the tables below it can clearly be observed that affective relevance judgements are used to evaluate documents in terms of both use and non-use.

Table 5.8. Negative affective relevance judgements made together with reasons for document use

Reasons for use	Relevance type	% N=106
I know the work of this author	Uncategorized	9.43
Sub-total for uncategorized		**9.43**
Emotional response with regard to viewpoint congruence	Affective	0.94
Sub-total for affective relevance		**10.37**
Machine matching	Algorithmic	14.15
Sub-total for algorithmic relevance		**14.15**
Specificity in terms of background or specific information	Cognitive	1.89
Tangibility in terms of proven information, hard data or facts	Cognitive	2.83
Supports current state of knowledge	Cognitive	22.64
Sub-total for cognitive relevance		**27.36**
Usefulness with regards to specificity or depth	Situational	0.94
Accessibility or availability within work task or situation	Situational	10.38
Current or recent in terms of work task or situation	Situational	0.94
Tangibility in terms of work task - hard data, facts	Situational	0.94
Sub-total for situational relevance		**13.2**
Acceptable within a socio-organizational domain	Socio-cognitive	9.43
Consistent with or supported by others in the field	Socio-cognitive	5.66
Sub-total for socio-cognitive relevance		**15.09**
Topicality / aboutness	Topicality	19.81
Sub-total for topical relevance		**19.81**
	Total	**100.00**

Question 2 in Section B allowed respondents to state their own reasons for using a document in addition to the pre-coded options offered. The nature of the distribution of variables over all the relevance types as defined in Chapter 3 can be seen in Table 5.8 above. The sub-totals for each of the relevance types should, however, not be taken to be an indication of the distribution of relevance types in general. The most unexpected result from these data was the fact that a relatively high percentage of the affective relevance judgements were made in conjunction with algorithmic relevance. Tracing back the individual questionnaires showed that these were mainly documents found on the Web. It can therefore be deduced that there is a greater possibility of

electronic documents being evaluated negatively on an affective level than print documents. Possible reasons could be inferior lay-out, use of fonts and colours on the Web.

Table 5.9. Negative affective relevance judgements made together with reasons for regarding a document as useful

Reasons for usefulness	Relevance type	% N=152
It provided background information	Cognitive	25.66
It provided detail information	Cognitive	13.16
It told me something I did not know	Cognitive	18.42
It verified something I already knew	Cognitive	11.83
It helped me make a decision	Cognitive	10.53
Sub-total for cognitive relevance		**79.6**
It changed the focus of my paper	Situational	3.95
It helped me solve a problem	Situational	7.89
Sub-total for situational relevance		**11.84**
It is meaningful within the theme of the conference theme/degree course/journal focus	Socio-cognitive	4.61
It has an interesting/unusual perspective on the conference theme/degree course/journal focus	Socio-cognitive	3.95
Sub-total for socio-cognitive relevance		**8.56**
	Total	100

Table 5.10. Negative affective relevance judgements made together with stated knowledge of the terminology of a document

Aspect related to the terminology used in the document	Relevance type	% N=134
The terminology is known to me	Cognitive	30.59
Terminology not known before reading the document	Cognitive	8.96
Use the same terminology	Cognitive	26.12
I will consider using this terminology in future	Cognitive	8.96
Sub-total for cognitive relevance		**74.63**
Similar to terminology in the field	Socio-cognitive	25.37
Sub-total for socio-cognitive relevance		**25.37**
	Total	**100**

Table 5.11. Negative affective relevance judgements made together with reasons for regarding a document as useful – not cited

Reasons for usefulness	Relevance type	% N=32
Provided background information	Cognitive	34.38
Similar theoretical viewpoint to my research	Cognitive	28.13
Provided particular focus/approach	Cognitive	6.25
Sub-total for cognitive relevance		**68.76**
Author has an interesting, but different approach to the problem	Socio-cognitive	31.25
Sub-total for socio-cognitive relevance		**31.25**
	Total	**100.01**

Table 5.12. Negative affective relevance judgements made together with reasons for not using a document

Reasons for not using the document	Relevance type	% N=91
Taught me nothing new	Cognitive	10.99
Provided good overview, but too elementary/superficial	Cognitive	9.89
Viewpoint of document does not support approach to the topic	Cognitive	12.09
Sub-total for cognitive relevance		**32.97**
Could not use the information in a meaningful way	Situational	28.57
Not familiar with author's work	Situational	7.69
Not accessible/available in work task/situation	Situational	2.20
Sub-total for situational relevance		**38.46**
Topic of document is different from topic of research or the viewpoint is not in accordance with conference theme/journal focus/degree course	Socio-cognitive	19.78
Someone else commented negatively on the document, it was not cited in any other document or I read another document that commented negatively on this one	Socio-cognitive	8.79
Sub-total for socio-cognitive relevance		**28.57**
	Total	**100**

Table 5.13. Negative affective relevance judgements made together with stated relationship with the author of a document – not cited

Aspect with regard to the author	Relevance type	% N=29
I know the author personally	Affective	0.00
Sub-total for affective relevance		**0.00**
I will consider using this author's work again	Cognitive	55.17
Sub-total for cognitive relevance		**55.17**
I am familiar with the author's work	Socio-cognitive	10.34
I have used this author's work before	Socio-cognitive	34.48
Sub-total for socio-cognitive relevance		**44.82**
	Total	**99.99**

It should however be noted that, due to the stated aims and consequent structure of this questionnaire, the distribution of relevance types over these tables should not be taken as a representation of relevance distribution in general.

From the findings in this sub-question (SQ_5), it has been demonstrated that there are elements of affective relevance present in all other relevance types. It is therefore concluded that *affective relevance*, as modelled in Figure 3.3 and discussed in Section 3.6.6, is another dimension of relevance judgements that may be associated with other subjective types of relevance, albeit in a random way.

5.2.7. Sub-question 6

Does socio-cognitive relevance exist separately from cognitive relevance? (SQ_6)

In Section 3.6.5 socio-cognitive relevance was defined as the relation between the situation, the work-task or problem at hand in a given socio-cultural context on the one hand and the information object on the other, as perceived by a cognitive agent. Cognitive relevance was defined in Section 3.6.3 as the relation between the state of knowledge, or cognitive information need of the user, and the information objects as interpreted by that user.

In order to answer this research question, it was necessary to establish whether or not *socio-cognitive relevance* is an important consideration when evaluating documents for use. See also the second sub-question under the main question (MQ_{D2}) in Section 5.2.1. above.

In order to establish the validity of this premise, the data sets from variable V33 in Section B and V36 in Section C (both binary statements answering the question of whether the academic standard of the document will be viewed favourably by the peers of the respondent) have been used to generate two new tables. The data set in Table 5.14 (see also Table F.1 in Appendix F) was used to establish the importance of the (perceived or real) evaluation of the document by peers (as representative of a socio-cultural or socio-cognitive domain) in the decision by the respondent to use a document. The data set regarding the socio-cognitive relevance was cross-tabulated with issues dealing with

- the importance of the document in the formulation of the research focus,
- the respondent's relationship with the author of the document,
- the degree of viewpoint congruence between the respondent and the author of the document,
- the perceived or real importance of the document in terms of the work task execution, and
- the socio-cognitive impact of the document within the domain.

Some of these issues dealt with graded relevance assessments, and others with socio-cognitive acceptability of the quality of the documents. The data set in Table 5.15 indicated just the opposite, namely the importance of the (perceived or real) evaluation of the document by peers (as representative of a socio-cultural or socio-cognitive domain) in the decision by the respondent not to use a document.

Table 5.14. The impact of socio-cognitive relevance considerations on document use

Description of variable	The academic standard of the document will be viewed favourably by my peers			Total %
	N	Yes %	No %	
This paper was very important in the formulation of your research problem	104	100.00	0.00	100.00
This paper was fairly important in the formulation of your research problem	151	91.39	8.61	100.00
This paper was not really important in the formulation of your research problem	65	84.62	20.31	100.00
The document is meaningful with the conference theme	**38**	**97.37**	**2.63**	**100.00**
The viewpoint of this document has an interesting/unusual perspective on the conference theme	**20**	**75.00**	**25.0**	**100.00**
I agree fully with the viewpoint of the author	129	99.22	0.78	100.00
I agree with most of the viewpoint of the author	159	93.08	6.92	100.00
I agree with some of the viewpoint of the author	31	64.52	35.48	100.00
I don't agree with the viewpoint of the author at all	1	100.00	0.00	100.00
I am familiar with the author's work	**144**	**95.14**	**4.86**	**100.00**
I know the author personally	**47**	**97.87**	**2.13**	**100.00**
I have used the author's work before in my papers	**97**	**97.94**	**2.06**	**100.00**
I will consider using the work of this author again	**233**	**95.71**	**4.29**	**100.00**
The terminology is similar to the terminology used in other documents in this field	**222**	**93.24**	**6.76**	**100.00**
I could not have completed my paper without this document	96	98.96	1.04	100.00
I would have been able to complete my paper without this document, but it would have been difficult	145	95.86	4.10	100.00
I would have been able to complete my paper without this document with no difficulty	79	79.75	18.99	100.00

Table 5.15. The impact of socio-cognitive relevance considerations on the non-use of documents

Description of variable	The academic standard of the document will be viewed favourably by my peers			Total %
	N	Yes %	No %	
The author has an interesting, but different approach to the problem	27	88.89	11.11	**100.00**
The viewpoint of this document is not in accordance with the conference theme	11	81.82	18.18	**100.00**
Someone else had read this document and commented negatively on it	5	40.00	60.00	**100.00**
It was not cited in any other document	6	66.67	33.33	**100.00**
I read another document that commented negatively on this one	1	100.00	0.00	**100.00**
The terminology is similar to the terminology used in other documents in this field	99	80.81	19.19	**100.00**

As can be observed in Table 5.14, a very small percentage of documents used by the respondents would not have been viewed favourably by their peers. This may be interpreted that it is a matter of concern to respondents whether or not the document used will be acceptable within a particular socio-cognitive domain. The percentages in Table 5.14 for documents that would not have been viewed favourably by the respondents peers are substantially higher than in Table 5.15. However, these documents were not used, once again supporting the assumption that it is important for respondents that the document will be acceptable within a particular domain. It may therefore be concluded that the notion of socio-cognitive relevance does exist and it is an important consideration when users judge the relevance of documents. This conclusion also effectively answers the derived question MQ_{D2} posed at the beginning of this chapter. Refer also to the discussion of SQ_4 above for more detail on the socio-cognitive relevance type.

The next phase was to address what could be considered the main issue regarding this sub-question (SQ_6), namely whether or not socio-cognitive relevance exists separately from cognitive relevance. This was tested as follows:

Where respondents indicated in Section B (relevant documents) that their peers would not approve of either the viewpoint (V32) of the document or its quality (V33), it was assumed that a definite socio-cognitive relevance judgement had been made. These data sets on socio-cognitive relevance judgements (positive as well as negative) were then cross-tabulated with the following data sets regarding cognitive relevance judgements obtained from in *Question 2* (reasons for use) and *Question 5* (reasons for usefulness) from Section B of the questionnaire.

- V7 = 28 (supports current state of knowledge)
- V11 or V12 or V13 = 1 or 7 or 9 or 11 or 14 or 28 or 29 (these were open-ended questions which were post-coded according to Table 4.3.)
- V16 = 1 (background or specific information need)

- V17 = 11 (real information needs - hard data, facts, figures)
- V18 = 29 (enhances current state of knowledge)
- V19 = 28 (supports current state of knowledge)
- V22 = 7 (clarity of presentation in terms of information need)
- V24 = 26 (although this is strictly speaking not a cognitive relevance judgement, the cross-tabulation yielded interesting results and is therefore included in the discussion)

Two tables were generated: Table 5.16 contains the results of the cross-tabulation of the data set for V32 (judgement of the peers regarding the viewpoint of the document) with the data set for the cognitive relevance judgements as described above. Table 5.17 contains the results of the cross-tabulation of the data set for V33 (the judgement of the peers regarding the quality of the document) with the same data set for cognitive relevance. Due to the small sample sizes in some instances, it was not possible to perform statistical significance tests, and the results have been discussed within context.

Table 5.16. Cognitive relevance judgements made in conjunction with socio-cognitive relevance regarding academic standards of documents

The academic standard of the document will be viewed favourably by my peers	Work tasks								
	Theses			Articles/Papers			Class assignments		
	N	Yes %	No %	N	Yes %	No %	N	Yes %	No %
V7=28 Supports current state of knowledge	99	95.96	4.04	56	96.43	3.57	26	88.46	11.54
V11=1 Background/specific information need	3	100.00	0.00	5	100.00	0.00	1	100.00	0.00
V11 or V12=11 Real needs - hard data, facts, figures	10	100.00	0.00	3	100.00	0.00			
V11=28 Supports current state of knowledge	1	100.00	0.00						
V11=29 Enhances current state of knowledge	1	100.00	0.00						
V16=1 It provide me with background information	111	86.49	13.51	60	96.67	3.33	32	90.63	9.38
V17=11 Real needs - hard data, facts, figures	85	96.47	3.53	39	97.44	2.56	28	100.00	0.00
V18=29 It told me something I did not know	79	88.61	11.39	34	100.00	0.00	32	90.63	9.38
V19=28 Supports current state of knowledge	75	90.67	9.33	44	100.00	0.00	16	93.75	6.25
V22=7 Clarity in terms of information needs	55	94.55	5.45	6	100.00	0.00	20	90.00	10.00
V24=26 The viewpoint of this document has an interesting/unusual perspective on the work task	9	77.78	22.22	6	100.00	0.00	6	60.00	40.00

Table 5.17. Cognitive relevance judgements made in conjunction with socio-cognitive relevance regarding viewpoint congruence of documents

The viewpoint of the document will be viewed favourably by my peers	Work tasks								
	Theses			Articles/Papers			Class assignments		
	N	Yes %	No %	N	Yes %	No %	N	Yes %	No %
V7=28 Supports current state of knowledge	99	95.96	4.04	56	87.50	12.50	26	96.15	3.85
V11=1 Background/specific information need	3	100.00	0.00	1	100.00	0.00			
V11=2 Sufficient detail/depth				4	100.00	0.00			
V11 or V12=11 Real needs - hard data, facts, figures	10	100.00	0.00	3	100.00	0.00			
V11=28 Supports current state of knowledge	1	100.00	0.00	2	50.00	50.00			
V11=29 Enhances current state of knowledge	1	100.00	0.00						
V16=1 It provide me with background information	111	91.89	8.11	60	93.33	6.67	32	96.88	3.13
V17=11 Real needs - hard data, facts, figures	85	97.65	2.35	39	92.31	7.69	28	100.00	0.00
V18=29 It told me something I did not know	79	91.14	8.86	34	94.12	5.88	32	96.88	3.13
V19=28 Supports current state of knowledge	77	96.00	4.00	44	90.91	9.09	16	100.00	0.00
V22=7 Clarity in terms of information needs	55	94.55	5.45	6	66.67	33.33	20	100.00	0.00
V24=26 The viewpoint of this document has an interesting/unusual perspective on the work task	9	77.78	22.22	6	100.00	0.00	5	80.00	20.00
V11=4 Acceptable within socio-organizational environment (accuracy/validity)	12	75.00	25.00	6	100.00	0.00			

From the aforegoing analysis it may be concluded that socio-cognitive relevance judgements seem very important when evaluating documents. There is a consistently high percentage in the columns where socio-cognitive relevance judgements are made (the "yes" columns in the two tables above).

However, there are some interesting deviations which are statistically significant and that show that positive cognitive relevance judgements are sometimes made within a negative socio-cognitive relevance judgement. These will be discussed below. Please note that these data sets should not be compared with the data sets in Table 5.7 (nesting) since the data described here are related to cross-tabulation of specific questions in the questionnaire. Whereas Table 5.7 indicates a very high incidence of both socio-cognitive and cognitive relevance judgements in general, the data sets described here shows some aspects of the actual relationship between these two types of relevance judgement.

It may be deduced from Table 5.16 that respondents who wrote articles and papers will very seldom cite a document that is not of acceptable quality within their domain. Students on the other hand, both undergraduate and post-graduate, will cite documents of dubious quality if they learnt something new from that document (V16, V18) or if they considered that it supported their state of knowledge (V7, V19).

It may be deduced from Table 5.17 that respondents who wrote articles and papers will cite documents whose viewpoint they consider will not be judged favourably by their peers, provided that these documents support their current state of knowledge (V7, V11, V19). Undergraduate students will not readily cite documents of which the viewpoints are not acceptable in their domain. Masters and doctoral students are likely to cite these types of documents only if it enhances their current state of knowledge (v16, V18).

From the aforegoing analysis there is a strong indication that cognitive relevance does exist separately from socio-cognitive relevance. Judging by the data gathered (see also discussion under SQ_4), both cognitive and socio-cognitive relevance play a significant role in the evaluation of documents, and the exact relationship between these two relevance types needs further investigation.

A further interesting observation is the relatively high percentage of students (both postgraduate and undergraduate) who indicated that even if neither the viewpoint nor the quality of the document would be acceptable within the domain, the document was still used because it had an interesting or unusual perspective on the work task (see the data in the shaded lower section of Tables 5.16 and 5.17). On the other hand, none of the respondents who were writing papers cited the document if it was not acceptable within the domain. Furthermore, the respondents who in the open questions listed a "4", namely acceptable/accurate within socio-organizational domain as a reason for document use, had a similar distribution (see Table 5.17 above). Although the number of responses to these questions were relatively low, this phenomenon was sufficiently interesting to initiate a reiterative review of the reasons stated in the original answer sheets. The 12 documents evaluated by masters and doctoral students and the six documents evaluated by authors of papers stated that either the supervisor (or other third party) advised them to use the document, or that the document was regarded as a seminal or "classic" text. In the case of the post graduate students, three out of the 12 considered that even though the document was used, the viewpoint would not be viewed favourably within the domain, whereas all six the documents evaluated by the authors of papers or articles indicated that it would.

A possible explanation for the fact that sub-standard documents are readily used and cited by students but not by authors of papers or articles is that students have to prove that they have undertaken a comprehensive literature review. They will therefore read and cite documents if their cognitive state has

been supported or enhanced, whereas authors of papers are expected to move to a next level where research is reported succinctly, and should not include a report of the groundwork.

On the other hand, authors of papers will more readily cite documents which supply and alternative viewpoint, even though it may not be accepted by their peers, because they might want to stimulate debate, open new avenues of research, etc. Students do not normally speculate in this manner, because lecturers expect them to know the basics of the subject before they can start experimenting.

5.3. Summary of findings

In this chapter various aspects of the model derived in Chapter 3 were tested empirically, based on the research questions posed in Chapter 1. The main findings were the following:

- Through the process of mapping relevance types and relevance attributes to derive a model of relevance types, it has been shown that these relevance types can be identified in terms of relations between elements in the process of cognitive information transfer. It was also shown that the model is a viable way of typifying relevance types, firstly through back-mapping of existing research, and then by testing some aspects of the model through new empirical research.

- It was found that the type of work task performed has an influence on the type of relevance judgement that is made. This is specifically so that situational relevance judgements are associated with work task execution and that affective, topical, cognitive and socio-cognitive relevance judgements are associated with search task execution.

- It was also shown that the relevance types are not necessarily nested, as previously assumed. Certain interesting correlations between

relevance types were observed, notably that between cognitive and socio-cognitive relevance, and this aspect should be studied in more detail.

- Elements of affective relevance were found to be present in all the other relevance types – algorithmic, topical, cognitive, situational and socio-cognitive relevance.

- Finally, it has been demonstrated that socio-cognitive relevance as a manifestation does exist, that acceptability within a particular socio-cognitive domain is regarded as very important and that socio-cognitive relevance exists separately from the manifestation of cognitive relevance.

Conclusions regarding the model and the empirical findings have been stated in Chapter 6.

CHAPTER 6: CONCLUSIONS REGARDING MODELLING AND EMPIRICAL DATA

The following conclusions can be drawn from the research into the background to the problems of relevance research, the development of the model in this study and the empirical research in support thereof.

6.1. Conclusions from the literature review

It is clear from the literature review in Chapter 2 and the historic development of relevance research that there are gaps in the research. Relevance research is fragmented and there is a lack of common direction. Studies have identified a multitude of relevance types and there are clear overlaps between many of them, but researchers appear to be vague on the linkages between the studies. It was concluded that there is a need to pull relevance research into a comprehensive, holistic framework, and that it was necessary to develop a model of the type as described in Chapter 3.

6.2. Conclusions regarding the model developed

The model described relevance as relations between information objects as perceived and the various stages of the information seeking and retrieval process. It was based on an existing and widely accepted model of information transfer. It was initially pre-tested by back-mapping previous empirical research and it was then concluded that the model is a viable tool for relevance research. Subsequent empirical research supported the relationships described. It may therefore be concluded that the framework of the model is clearly capable of providing a comprehensive description of the interactions in relevance judgements.

From the specific empirical work in support of various aspects of the model it may be concluded that:

- The type of work task performed has an influence on the type of relevance judgements made. Topical, cognitive, socio-cognitive and affective relevance judgements are made more often during search task execution, and situational relevance is more strongly associated with work task execution.
- Relevance types are not necessarily nested, although interesting correlations between certain relevance types were observed. This particular issue requires further study.
- Affective relevance judgements may be made together with all other relevance judgements, even algorithmic.
- Even though socio-cognitive relevance exists separately from cognitive relevance, the former is regarded by users as a very important criterion when judging the relevance of an information object.

6.3. Conclusions for future research

It is essential to understand the manner in which relevance is judged in order to improve the representation of and access to information. It would thus be advantageous in current and future research to address each relevance type in terms of the holistic approach postulated by this model. This has been done in overview in the next chapter in order to provide some guidelines for future work.

CHAPTER 7: IMPLICATIONS OF THE MODEL FOR IR RESEARCH

Traditionally, the focus of IR research is on topicality as the deciding criterion for relevance. This study has confirmed that users also judge relevance on levels other than topicality. The question then is: *How can systems be improved in order to help users to make relevance judgements on other levels as well?*

The purpose of this chapter is to review the larger significance of the results regarding the implementation of the findings in terms of the possible applicability of the framework defined by the model as defined in Chapter 3.

It is essential to understand the manner in which relevance is judged in order to improve the representation of, and access to information. The analysis presented here provides a guideline for future research on relevance, and should be seen as a possible contextualisation of the model (as proposed in this thesis) within current research projects. The research in the field has been mapped to the model in order to expose the "bigger picture" of what is being done within relevance research. Although the list of studies reviewed below cannot be regarded as being comprehensive, all the studies mentioned already have as underlying theme the understanding of various types of relevance judgements as made by users of IR systems.

Each of the relevance types has been discussed briefly in order to re-establish the parameters of the definitions of the relevance types. These definitions are important, because these are the parameters in which the argument will take place. It is acknowledged that relevance is a fuzzy concept and that definitions vary, but by defining each manifestation clearly and only arguing within those parameters, misunderstandings should be minimized.

For each of these studies, the recent and current research into facilitating these relations in the search process has been analysed, with the focus on the more subjective relevance types of cognitive, situational and socio-cognitive relevance.

7.1. Algorithmic relevance

In the model as depicted in Figure 3.3, the relation is defined as that between the query and the information objects. This relation is system-oriented to a very large extent, as it depends on the degree of similarity between the features of the query and the features of the information object. This type of relevance is by nature system-dependent. It is not influenced by the user, nor is it related to any subjective information need the user may have.

System or algorithmic relevance is measured in terms of the comparative effectiveness of logical or statistical similarity of features inferring relevance. There are various models of matching the query (as a representation of the user's need) to the information objects (whether as full-text or as representations). Systems may be Boolean (exact match) or best-match (for example vector space, probabilistic, etc.) in nature, or a combination of both. See Figure 3.1 for a classification of retrieval techniques. Although it was stated that this study will limit its scope to the more subjective types of relevance judgements, the concept of algorithmic relevance is, nevertheless, included in the model and therefore a brief review of recent projects aiming to increase the comparative effectiveness of the relation between the query and the information objects has been given.

One of the most enduring debates within the systems approach to IR is the use of natural language versus controlled vocabulary to improve retrieval. A recent study in this field was done by Tomaiuolo and Packer (1998). A subset of this type of research is the work of researchers such as Sanderson (2000) on sense disambiguation. Other researchers concentrate on improving relevance feedback methods, for example the research by Voorhees (1998)

on the role of assessors in measuring relevance feedback, Lee (1998) on multiple evidence from relevance feedback methods, Lam-Adesina and Jones (2001) on summarization techniques for term selection in relevance feedback, Voorhees (1999) on the validity of TREC for using relevance as a measurement of retrieval effectiveness and Voorhees (2001) on the role of highly relevant documents in system evaluation. Another recent area of research within the systems relevance is that of partial or graded relevant assessments, for instance the work of Järvelin and Kekäläinen (2000) on discounted cumulative gain which incorporates multiple relevance levels into a single measure and Kekäläinen and Järvelin (2002) on graded relevance assessments in IR evaluation.

The focus of the studies mentioned above is algorithmic relevance in the model derived in this study – the relation between the query and the information objects. Traditional Boolean systems facilitate binary relevance judgements, whereas best match systems, or a combination of best match and Boolean systems, are able to rank retrieved information by relevance. It is clear that even in systems relevance research there has been a move away from the traditional binary relevance judgements and a greater appreciation for the fuzziness of relevance judgements made by users and the need for interactive information retrieval (IIR). Therefore, research on retrieval systems improvement should focus more on facilitating fuzzy relevance judgements.

7.2. Topicality

Topical relevance is defined as the relation between the topic of the query and the topic of the assessed information objects. The finding of focus during the formulation of the request by the user, which is then transformed into a query by the system, is the criterion whereby topicality is inferred. The assumption is that both request and the objects may be assessed by a cognitive agent as being about the same or a similar topic, which implies a degree of subjectivity. The assessment is even less reliable if the information objects are represented by human-indexed terms.

Improving the relationship between the request and the information objects in terms of topicality is the focus of IR systems. Interesting new developments in the field of information representation, might prove to be useful in assisting users to judge potentially useful documents on a topical level.

Although not empirically supported, Ford's (1999) discussion of the possibilities offered by machine processing of similarities through high order knowledge representation and fuzzy (or parallel) IR is summarised here as a case in point.

7.2.1. High order knowledge representation

Relatively high order knowledge representations may be facilitated by linguistic analysis whereby similarity relationships at a relatively high level of abstraction can be made. A system such as DR-LINK "... can retrieve related articles that would not be found in a Boolean search because they contain the ideas, not the precise words, that were requested" (Feldman as quoted in Ford, 1999). This is still not enough, for current research, according to Ford (1999), is focussed (*within narrow subject domains*) on:

- the computation of argumentation (components and structures of arguments are represented in such a way that patterns of argument and counter-argument may be mapped onto each other and compared for similarities and differences);
- analogy-based representations and processing to support case-based reasoning (similarities are represented and then matched between stored cases of solved problems so that solution structures of known problems may be applied to new ones);
- the direct modelling of analogical reasoning (attempts to model human analogical reasoning to computers as well as commercial analogical problem-solving systems); and
- information abstraction (structured knowledge representation of complex events, situations or relationships are created and then populated with text extracted from unstructured natural language texts).

The common thread in these studies is the specification of relationships between structural components at a level of abstraction higher than mere morphological or syntactical analysis, "and of more complex semantic patterns than relative simple thesaural links" (Ford, 1999).

7.2.2. Fuzzy and parallel IR

Often neural networks (employing fuzzy, parallel processing though pattern matching), focus on sub-semantic levels (e.g. image processing). Some systems, however, also use nodes to represent keywords and documents on a semantic level. Examples of these representations are taxonomies and ontologies (Welty & Guarino, 2001) and topic maps (Pepper, 2000). Knowledge of the relationship between query and documents is then stored in the pattern of links between the nodes (Ford, 1999).

By using higher order knowledge representation and fuzzy and parallel IR, systems tend to become more intelligent. Although this type of research is relatively new, it is quite feasible that technologies such as those described above, may aid users in the judging of topically relevant information, by supplying wider information content than simply that which was requested through the query. Typical projects on these matters are for instance those related to sense disambiguation (Sanderson, 2000), Park's (1995) work on inferential representation of documents within subject fields and Choi and Rasmussen's (2001) work on image retrieval based on topicality.

7.3. Cognitive relevance / pertinence

Pertinence is measured in terms of the relation between the state of knowledge, or cognitive information need of the user, and the information objects as interpreted by that user. The *criteria* by which pertinence are inferred are cognitive correspondence, informativeness, novelty and information preferences. For instance, a paper may be topically relevant but

repeating what the user already knows. Cognitive relevance is clearly a very subjective judgement, as opposed to algorithmic and topical relevance as discussed above. The question on how to induce and facilitate the novelty value of information to users, must therefore by addressed on an entirely different level.

Traditional IR systems allow users to modify queries according to their own understanding of the problem. This, in turn, depends on the user's conceptual knowledge background and his understanding or perception of his information need. Toms (1998) uses an interesting set of analogies to describe this aspect of seeking: "Sometimes people seek a target with the precision of a cruise missile. Sometimes they seek a target with the imprecision of a Christmas shopper."

The fact that the success of a query to retrieve cognitively relevant information depends on the user's understanding of both the system and the user's own problem space, tends to limit the possibility of the user finding relevant information. In recent research, however, there has been attempts to induce and facilitate serendipitous information retrieval. To continue with Toms' (1998) analogy: "Sometimes a target appears - unexpected and unsought, such as the five dollar bill fluttering in the fall leaves."

According to Toms (1998) there are essentially three ways to acquire information:

1. searching for information about well-defined and known objects;
2. searching for information about an object that cannot be described, but which will be recognized on sight; and
3. accidental, incidental or serendipitous discovery of an object.

She contends that current information retrieval systems are based on the assumption that users know (or partially know) the object of their search, and that serendipitous information retrieval is largely ignored in information system development and research (Toms, 2000).

According to Figueiredo and Campos (2001), classic problem solving first requires a recognition of the problem, then some sort of divergence taking place and ultimately converging into a novel solution for the problem. Serendipity, on the other hand, is a creative process, whereby an attempt to solve a problem leads first to a divergence, and then to a new problem or a solution to a problem that was not known to exist. Serendipity is also defined by Quéau (quoted in Figueiredo & Campos, 2001) as "the art of finding what we are not looking for by looking for what we are not finding".

It is generally acknowledged that qualitative research sometimes contains "good fortune", but according to Fine and Deegan (1996), serendipity consists in how this fortune is transformed into substantive discovery. Serendipity is therefore not only a "chance encounter" (Toms, 2000), but more than that – it is the "unique and contingent mix of insight coupled with chance" (Fine & Deegan, 1996). Furthermore, Spink and Greisdorf (1997) found that highly relevant documents do not often change the user's cognitive or information space, but partially relevant documents do.

Serendipity rests on the three principles of insight, chance and discovery (Fine & Deegan, 1996). The principles of chance and discovery could be built into systems, for example though improved browsing facilities (see Toms (1998) for an example of such a system). However, the first principle, that of insight, rests solely with the user. To quote Louis Pasteur: "Chance favours only the prepared mind" (Oxford Dictionary of Quotations, 1979).

Although the research focus of serendipitous retrieval is not necessarily that of helping users that cannot formulate their own information need satisfactorily, it is plausible that it may be utilised as an aid to users who cannot express their query to a sufficient degree. Research, such as that of Toms (1998; 2000) is very important in terms of the improvement of IR systems in order to assist users to judge relevance on a cognitive (personal) level.

Another important contribution within this focus of cognitive relevance judgements, is the research on profile building for information filtering. Coupled with browsing, personalization of information retrieval can help people to find information with potential value to their information needs. With regard to the internet, Bowman et al. (1994) note "at least 99% of the available data is of no interest to at least 99% of the users". Personalization of information delivery relies on systems that selectively weed out the irrelevant information based on the user's preferences (Quiroga & Mostafa, 2001). Although this has been said in a different context, it is clear that *cognitive relevance* is implied.

7.4. Situational relevance

Situational relevance describes the relationship between the perceived situation, work task or problem at hand and the usefulness of the information objects as perceived by the user. The criteria by which situational relevance is inferred are usefulness in decision-making, appropriateness of information in problem solving and the reduction of uncertainty.

According to Borlund (2000) "... the judgement of situational relevance embraces not only the user's evaluation of whether a given information object is capable of satisfying the information need, it offers also the potential of creating new knowledge which may motivate change in the decision maker's cognitive structures. The change may further lead to a modification of the perception of the situation and the succeeding relevance judgement, and in an update of the information need".

Subjective relevance types, including situational relevance, are generally accepted to be both dynamic and multidimensional in nature. In the information seeking process, these relevance types are continually and interactively assessed. This assessment is not binary, but rather judged as degrees of relevance. In order for systems to support the searching

behaviour of users in this context, it must allow for interactive information retrieval. See Borlund (2000) for the evaluation of such systems, and Savage-Knepshield and Belkin (1999) for a historical overview of trends in interactive IR (IIR).

Situational relevance in this study was found to be more strongly associated with work task execution than with search task execution. Therefore, interactive IR should also support searching over more than one session, and complex profiling should be able to dynamically include changing situational factors as well.

7.5. Socio-cognitive relevance

Socio-cognitive relevance is, together with cognitive, situational and affective relevance, regarded as a subjective relevance type. Socio-cognitive relevance describes the relationship between the situation, the work-task or problem at hand in a given socio-cultural context on the one hand, and the information objects on the other, as perceived by one or more cognitive agents. The social or organizational domain, or cultural context in which the individual finds himself is defined by a paradigm, which dictates what problem explanations may be found to be acceptable.

Retrieval of information limited to particular paradigms or socio-cultural or socio-cognitive domains may not be easily solved by improvement to systems. Facilitating serendipity or IIR may yield somewhat improved results, but in general the nature of socio-cognitive relevance is such that metadata would probably be the best solution to this particular problem.

The purpose of metadata is to describe the structure of the content data, and more importantly, to capture any additional properties that may characterise it. Metadata formats are divided into three categories: simple, rich and structured (Hakala, 2001):

- *Simple formats* are proprietary and based on full text indexing. This type of data is created by search engine crawlers. They are easy to use, but are weak for information retrieval purposes, as they do not support field searching.
- *Rich formats* are associated with research and scholarly activity, and require specialist subject knowledge to create and maintain. These formats are usually based on international standards, e.g. MARC (Machine-Readable Cataloguing), FGDC (Federal Geographic Data Committee), ICPSR (Interuniversity Consortium for Political and Social Research – an SGML codebook initiative describing social societies), CIMI (Computer Interchange of Museum Information), EAD (Encoded Archival Description) and CERIF (Common European Research Information Format).
- *Structured formats* are a compromise between simple and rich formats, specially developed for Internet usage. These include data that contain a detailed enough description to allow a user to assess the potential utility or interest of a resource without having to retrieve it. The data are structured and support field searching, but are still domain specific. Some structured formats are the IAFA (Internet Anonymous FTP Archive) templates; RFC (Internet Request for Comments) 1807 (format for bibliographic records); SOIF (Summary Object Interchange Format); and LDAP (Lightweight Directory Access Protocol) Data Interchange Format (LDIF). However, the Dublin Core Metadata Element Set (http://dublincore.org) is one of the first truly universal formats. This metadata element set is intended to facilitate the finding of electronic resources, originally conceived for author-generated descriptions of web resources.

The *de facto* standard for metadata, especially on the Web, is Dublin Core (DC). Dublin Core is a general set of metadata elements and is often enriched by application domain-dependent additions, such as the NDLTD (Networked Digital Library of Theses and Dissertations) and the LOM (learning object

metadata). The elements and definitions of DC are based on the official standard for the element set of DC (ANSI/NISO Z39.85-2001). The elements can be seen as describing three different dimensions of metadata, i.e. describing the content or *data*, describing the *source*, and describing the *collection process* to collect the content. This subdivision is very important, since it describes the reality of the aboutness, isness and processing of the information objects (Cosijn, et al., 2002).

It is especially the data elements that are related to the source that may be of importance for improving access to *socio-cognitively relevant* information objects. Metadata elements such as the following DC elements have great potential to help users to judge the relevance of retrieved information objects with regard to a particular situation, or within a particular socio-organizational domain during the search task:

- Type: Nature or genre of the content of the resource
- Format: Physical or digital manifestation of the resource
- Identifier: Unambiguous reference to the resource within a given context
- Source: Reference to a resource from which the present resource is derived
- Language: Language of the intellectual content of the resource
- Relation: Reference to a related resource, and
- Coverage: Extent or scope of the content of the resource.

Another technique that may be used to facilitate socio-cognitive relevance is that of co-citation analysis. Patterns of co-citation can help a searcher to understand which publications and authors may be grouped together in terms of their approach to a subject. This may then give an indication of acceptability within a particular socio-organizational domain.

An interesting study by Yuan and Meadow (1999) showed another possibility of improving access to socio-cognitively relevant documents. Authors in

different fields use different words to describe concepts, for example *data* and *information* is used differently in the fields of computer science and information science. Yuan and Meadow (1999) found that when two individual papers, or two authors over several works, use the same variables (or terms), it indicates a *similarity in approach* to the subject. According to them, if authors use the same variables, "such usage may be a stronger indication of similarity than co-citation because it represents what the authors did, rather than what they say" (Yuan & Meadow, 1999).

In traditional systems, both topicality and socio-cognitive relevance types were facilitated purely by human input. However, by using technologies such as described above, both these relevance types may be partially facilitated at a systems level.

7.6. Affective relevance

Affective relevance is described in terms of the relation between the goals, intents and motivations of the user and the information objects. Affective relevance should not be seen as the ultimate subjective relevance in a scale of relevances, but rather as another dimension of relevance judgments that may be associated with the other subjective types of relevance. As such, it is probably not possible to improve systems (other than profiling) or information representation to expressly facilitate this manifestation of relevance.

7.7. Conclusions

This study has aimed to improve our understanding of relevance by providing a model for understanding the concept of relevance in terms of relations between information objects on the one hand and the various aspects of the information seeking and retrieval process on the other.

In the historic development of IR as a field of study, three main research paradigms can be clearly identified – the systems approach, the user approach and the cognitive approach (Ingwersen, 1999). Recently the

emergence of a (tentative) fourth approach has become evident – the socio-cognitive or epistemological approach (Hjørland, 2002).

As stated in the first chapter, relevance may be regarded as the central and most fundamental concept within the field of information science. We are studying relevant information, not just any information. As such, relevance should not be studied from a limited perspective. Systems may be improved by making their algorithmic relevance scores better correlate with the subject, but users judge relevance from a much broader perspective – not only from a cognitive perspective, but also within an epistemological framework.

The model developed and tested in this study defines the various relevance types and their interconnectivity. From the additional information provided on the various manifestations in this concluding chapter it should be clear that these relevance judgements, either individually or jointly, may be and indeed need to be facilitated in some way by improving systems to make intelligent, interactive IR possible.

Relevance should be the one issue connecting the various approaches within information science. No single research paradigm should claim relevance for its own. In order to understand relevance, it is necessary to view the concept from a holistic perspective, taking into account the systems, the users, the cognitive overlaps of the role players within IR as well as the influence of the epistemological framework in which IR takes place. It is critical that future research in the field of IR should take all these factors into account.

REFERENCES

BAR-HILLEL, Y. (1958). Summary of Area 6 discussion. *Proceedings of the International Conference on Scientific Information*, Washington, DC.

BARRY, C.L. (1994). User-defined relevance criteria: An exploratory study. *Journal of the American Society for Information Science, 45*(3), 149-159.

BARRY, CAROL L. & SCHAMBER, L. (1998). User's criteria for relevance evaluation: A cross-situational comparison. *Information Processing and Management*, 34 (2/3), 219-236.

BELKIN, N. (1978). Information concepts for Information Science. *Journal of Documentation*, 34, 55-85.

BELKIN, N.J., COOL, C. STEIN, A. & THIEL, U. (1995). Cases, scripts and information seeking strategies: On the design of interactive information retrieval systems. *Expert Systems with Applications*, 9(3), 379-395.

BELKIN, N.J. & CROFT, W.B. (1987). Retrieval techniques. *In*: Williams, M.E. *ed. Annual Review of Information Science and Technology (ARIST)*. Medford, NJ: Learned Information, INC, 22, 109-145.

BLESS, C. & HIGSON-SMITH, C. (1995). *Fundamentals of social research methods: an African perspective*. Cape Town: Juta.

BOOKSTEIN, A. (1983). Outline of a general probabilistic retrieval model. *Journal of Documentation*, 39(2), 63-72.

BORLUND, P. (2000). *Evaluation of interactive information retrieval systems*. Doctoral dissertation. Åbo: Åbo Akademi University Press.

BORLUND, P. & INGWERSEN, P. (1988). Measures of relative relevance and ranked half-life: Performance indicators for interactive IR. *In*: Croft, *et al. eds. Proceedings of the 21st ACM SIGIR Conference on research and development of information retrieval*. Melbourne, Australia: ACM Press / York Press, 324-331.

BOWMAN, C.M., DANZIG, P.B., MANBER, U. & SCHWARTZ, F. (1994). Scalable internet resources discovery: research problems and approaches. *Communications of the ACM*, 37(8), 98-107.

BRAJNIK, G., MIZZARO, S., TASSO, K. & VENUTI, F. (2002). Strategic help in user interfaces for information retrieval. *Journal of the American Society for Information Science and Technology*, 53(5), 343-358.

BYSTRÖM, K. & JÄRVELIN, K. (1995). Task complexity affects information seeking and use. *Information Processing and Management*, 31(2), 191-214.

CHECKLAND, P. & HOLWELL, S. (1998). *Information, systems and information systems*. New York: Wiley.

CHEN, H. & DAHR, V. (1990). Online query refinement on information retrieval systems. *In*: Vidick, L.-L. *ed. Proceedings of the 13th ACM SIGIR Conference on research and development of information retrieval*. Bruxelles, Belgium: Bruxelles University Press, 115-132.

CHOI, Y. & RASMUSSEN, E. (2001). User's relevance criteria in image retrieval in American history. *Information Processing and Management*, 38, 695-726.

CHRISTENSEN, F.H., INGWERSEN, P. & WORMELL, I. (1997). Online determination of the journal impact factor and its international properties. *Scientometrics*, 40(3), 529-540.

COSIJN, E. (2003). Mapping relevance types in information behaviour. *Information Processing and Management*. In press.

COSIJN, E. & INGWERSEN, P. (2000). Dimensions of Relevance. *Information Processing and Management*, 36(4), 533-550.

COSIJN, E., PIRKOLA, A., BOTHMA, T. & JÄRVELIN, K. (2002). Information access in indigenous languages. *In*: Bruce, H. et al. *eds. Emerging frameworks and methods. Proceedings of the Fourth International Conference on Conceptions of Library and Information Science*. Greenwood Village, Colorado: Libraries Unlimited, 221-238

DERVIN, B & NILAN, M. (1986). Information needs and uses. *In*: Williams, M.E. *ed. Annual Review of Information Science and Technology (ARIST)*. Medford, NJ: Learned Information, INC, 21, 3-33.

DOYLE, L.B. (1963). Is relevance an adequate criterion for retrieval system evaluation? *In*: Luhn, H.P. *ed. Automation and scientific*

communication, short papers. Pt 2. Washington, DC., American Documentation Institute, 199-200.

FIGUEIREDO, A.D. (2001). The serendipity equations. *In*: Webber, R. and Gresse, C. *eds. Proceedings of the Workshop Program at the 4th International Conference on Case-based Reasoning, ICCBR01, Technical Note AIC-01-003*. Washington, DC: Naval Research Laboratory, Navy Centre for Applied Research in Artificial Intelligence. [Online]. Available http://www.aic.nrl.navy.mil/papers/2001/AIC-01-003 /ws4/ws4toc2.pdf [21November 2002].

FINE, G. & DEEGAN, J. (1996). *Three principles of serendip: insight, chance and discovery in qualitative research*. [Online]. Available: http://www.ul.ie/~philos/vol2/Deegan.html [21 November 2002].

FITGERALD, M.A. & GALLOWAY, C. (2001). Relevance judging, evaluation and decision-making in virtual libraries: A descriptive study. *Journal of the American Society for Information Science and Technology*, 52(12), 989-1010.

FORD, N. (1999). Information retrieval and creativity: towards support for the original thinker. *Journal of Documentation*, 55(5), 528-542.

FROELICH, T.J. (1994). Relevance reconsidered – towards an agenda for the 21st century: Introduction to special topic issue on relevance research. *Journal of the American Society for Information Science*, 45, 124-133.

GREISDORF, H. (2000). Relevance: An interdisciplinary and information science perspective. *Informing Science*, 3(1), 67-71.

GREISDORF, H. & SPINK, A. (1999). Regions of relevance: Approaches to measurement for enhanced precision. *In*: Landani, M. *ed. Draft Proceedings. 21st Colloquium on Information Retrieval*, Glasgow.

HAINES, D. & CROFT, W.B. (1993) Relevance feedback and inference networks. *In*: Korfhage, R. *et al. eds. Proceedings of the 16th ACM SIGIR Conference on research and development of information retrieval*. Pittsburgh, Pennsylvania, USA: ACM Press, 2-11.

HARTER, S.P. (1996). Variations in relevance assessments and the measurement of retrieval effectiveness. *Journal of the American Society for Information Science*, 47(1), 37-49.

HERNON, P. (1994). *Statistics. A component of the research process.* Rev. ed. Norwood, NJ: Ablex Publishing.

HJØRLAND, B. (2000). Letter to the editor: Relevance research: The missing perspectives: "non-relevance" and "epistemological relevance". *Journal of the American Society for Information Science and Technology*, 51(2), 209-211.

HJØRLAND, B. (2001). Brief communication: Towards a theory of aboutness, topicality, theme, domain, field, content ... and relevance. *Journal of the American Society for Information Science*, 52(9), 774-778.

HJØRLAND, B. (2002). Epistemology and the socio-cognitive perspective in information science. *Journal of the American Society for Information Science and Technology*, 53(4), 257-270.

HJØRLAND, B. & CHRISTENSEN, F.S. (2002). Brief communication: Work tasks and socio-cognitive relevance: a specific example. *Journal of the American Society for Information Science and Technology*, 53(11), 960-965.

INEX. (2002). *Relevance assessment guide.* [Online]. Available http://qmir/dcs/qmv.ac.uk/INEX. [19 October 2002].

INGWERSEN, P. & BORLUND, P. (1996). Information transfer viewed as interactive cognitive processes. *In*: Ingwersen, P. & Pors, N.O. *eds. Information Science: Integration in perspective*. Copenhagen, Denmark: Royal School of Library and Information Science, 219- 232.

INGWERSEN, P. (1982). Search procedures in the library analysed from a cognitive point of view. *Journal of Documentation,* 38(3), 165-191.

INGWERSEN, P. (1984). A cognitive view of three selected online search facilities. *Online Review*, 8(5), 465-492.

INGWERSEN, P. (1992). *Information Retrieval Interaction.* London: Taylor Graham.

INGWERSEN, P. (1996). Cognitive perspectives of information retrieval interaction: elements of a cognitive IR theory. *Journal of Documentation,* 52(1), 3-50.

INGWERSEN, P. (1999). Cognitive information retrieval. *In*: Williams, M.E. *ed. Annual Review of Information Science and Technology (ARIST).* Medford, NJ: Learned Information, INC, 34, 3-52.

JÄRVELIN, K. & KEKÄLÄINEN, J. (2000). IR evaluation methods for retrieving highly relevant documents. *In*: Belkin, N.J . *et al. eds. Proceedings of the 23rd Annual International ACM SIGIR Conference on Research and Development in Information Retrieval. Athens, Greece, 2000.* New York: ACM Press, 41-48.

JONES, K. (1999). Linguistic searching versus relevance ranking: DR-LINK and TARGET. *Online & CD-ROM Review*, 23(2), 67-80.

KEKÄLÄINEN, J. & JÄRVELIN, K. (2002). Using graded relevance assessments in IR evaluation. *Journal of the American Society for Information Science and Technology*, 53(13), 1120-1129.

KUHLTHAU, C.C. (1993). *Seeking meaning: a process approach to library and information science*. Norwood, NJ: Ablex Publishing.

KUHN, T.S. (1962). *The structure of scientific revolutions*. 2nd ed. Chicago: University of Chicago Press.

LAM-ADESINA, A.M. & JONES, G.J.F. (2001). Applying summarization techniques for term selection in relevance feedback. *In*: Croft, W.B. *et al. eds. Proceedings of the 24th Annual International ACM SIGIR conference on Research and Development in Information Retrieval.* New Orleans, Louisiana, USA. ACM Press, 1-9.

LANCASTER, F.W. (1968). *Evaluation of the Medlars Demand Service*. Bethesda, Md: National Library of Medicine.

LAVRENKO, V. & CROFT, W.B. (2001). Relevance-based language models. *In*: Croft, W.B. *et al. eds. Proceedings of the 24th Annual International ACM SIGIR conference on Research and Development in Information Retrieval.* New Orleans, Louisiana, USA. ACM Press, 120-127.

LEE, J.H. (1998). Combining the evidence of different relevance feedback methods for information retrieval. *Information Processing and Management*, 34(6), 681-691.

MAGLAUGHLIN, K.L. & SONNENWALD, D.H. (2002). User perspectives on relevance criteria: a comparison among relevant, partially relevant, and not-relevant judgements. *Journal of the American Society for Information Science and Technology*, 53(5), 327-342.

MIZZARO, S. (1997). Relevance: The whole history. *Journal of the American Society for Information Science*, 48(9), 810-832.

MIZZARO, S. (1998). How many relevances in information retrieval? *Interacting with Computers*, 10, 305-322.

NEUMAN, W.L. (1997). *Social research methods: qualitative and quantitative approaches*. Boston: Allyn & Bacon.

OOSTHUIZEN, S. (2001). *Relevance questionnaires*. Pretoria: University of Pretoria. (Unpublished B.IS Hons mini-dissertation).

OXFORD dictionary of quotations. (1979). Oxford: Oxford University Press.

PARK, H. (1996). Inferential representations of science documents. *Information Processing and Management*, 32(4), 419-429.

PATTON, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage Publications.

PEPPER, S. (2000). *The TAO of topic maps: finding the way in the age of infoglut*. [Online]. Available http://www.gca.org/papers/xmleurope2000/papers/s11-01.html. (13 March 2003).

PORS, N.O. (2000). Information retrieval, experimental models and statistical analysis. *Journal of Documentation*, 56(1), 55-70.

POWELL, R.R. (1997). *Basis research methods for librarians*. Greenwich, Ablex Publishing.

QUIROGA, L.M. & MOSTAFA, J. (2001). An experiment in building profiles in information filtering: the role of context of user relevance feedback. *Information Processing and Management*, 38(5),671-694.

REID, J. (1999). A new, task-orientated paradigm for information retrieval: implications for evaluation of information retrieval systems. *In*: Aparac,

T. *et al. eds. Proceedings of the CoLIS 3 Third International Conference on Conceptions of Library and Information Science: Digital Libraries. Interdisciplinary concepts, challenges and opportunities.* Zagreb, Croatia: University of Zagreb, 97-108.

SANDERSON, M. (2000). Retrieving with good sense. *Information Retrieval*, 2, 47-67.

SARACEVIC, T. (1975). Relevance: A review and a framework for the thinking on the notion in information science. *Journal of the American Society for Information Science*, 26, 321-343.

SARACEVIC, T. (1996). Relevance reconsidered '96. *In*: Ingwersen, P. & Pors, N.O. *eds. Information Science: Integration in Perspective*. Copenhagen, Denmark: Royal School of Library and Information Science, 201-218.

SARACEVIC, T. (1999). Information science. *Journal of the American Society for Information Science*, 50(12), 1051-1063.

SARACEVIC, T., KANTOR, P., CHAMIS, A.Y. & TRIVISON, D. (1988). A study of information seeking and retrieving. I. Background and methodology. *Journal of the American Society for Information Science*, 39(3), 161-176.

SAVAGE-KNEPSHIELD, P.A. & BELKIN, N. (1999). Information retrieval interaction: trends over time. *Journal of the American Society for Information Science*, 50(12), 1067-1082.

SCHAMBER, L. (1994). Relevance and information behaviour. In: Williams, M.E. *ed. Annual Review of Information Science and Technology (ARIST)*. Medford, NJ: Learned Information, INC, 29, 3-48.

SCHAMBER, L., EISENBERG, M.B. & NILAN, M.S. (1990). A re-examination of relevance: Toward a dynamic, situational definition. *Information Processing and Management, 26*(6), 755-776.

SEARLE, J.R. (1984). Intentionality and its place in nature. *Synthese*, 61, 3-16.

SHORTER Oxford English Dictionary on Historical Principles. (1973). Onions, C.T. *ed.* 3rd ed. Oxford: Clarendon Press

SPINK, A., GOODRUM.A. & ROBINS, D. (1998). Elicitation behaviour during mediated information retrieval. *Information Processing and Management*, 34(2/3), 257-273.

SPINK, A. & GREISDORF, H. (1997). User's partial relevance judgements during online searching. *Online and CDROM Review*, 21(5), 271-280.

SPINK, A. & GREISDORF, H. (2001). Regions and levels: Measuring and mapping user's relevance judgements. *Journal of the American Society for Information Science and Technology*, 52(2): 161-173.

SPINK, A., GREISDORF , H. & BATEMAN, J. (1998). From highly relevant to not relevant: Examining different regions of relevance. *Information Processing and Management,* 34(5), 599-624.

SU, L.T. (1998). Value of search results as a whole as the best single measure of information retrieval performance. *Information Processing and Management*, 34(5), 557-579.

TANG, R. & SOLOMON, P. (1998). Toward an understanding of the dynamics of relevance judgement: an analysis of one person's search behaviour. *Information Processing and Management*, 34(2/3), 237-256.

TANG, R. & SOLOMON, P. (2001). Use of relevance criteria across stages of document evaluation: on the complementarity of experimental and naturalistic studies. *Journal of the American Society for Information Science and Technology*, 52(8), 676-685.

TAUBE, M. (1965). A note on the pseudo-mathematics of relevance. *American Documentation*, 16(2), 69-72

TOMAIUOLO, N.G. & PACKER, J. (1998). Keyword and natural language searching. *Online*, November/December 1998, 57-60.

TOMS, E. (1998). *Information exploration of the third kind: the concept of chance encounters. A position paper for the CHI98 Workshop on Information exploration.* [Online]. Available: http://www.fxpal.com/ ConferencesWorkshops /CHI98IE/submissions/long/toms/Default.htm [21 November 2002].

TOMS, E. (2000). *Serendipitous information retrieval.* [Online]. Available: http://www.ercim.org/publication/ws-proceedings/DelNoe01/3-Toms.pdf [21 November 2002].

VAKKARI, P. (1999). Task complexity, problem structure and information actions. Integrating studies on information seeking and retrieval. *Information Processing and Management*, 35, 819-837.

VAKKARI, P. (2001a). Changes in search tactics and relevance judgements when preparing a research proposal. A summary of the findings of a longitudinal study. *Information Retrieval*, 4, 295-310.

VAKKARI, P. (2001b). A theory of the task-based information retrieval process: A summary and generalisation of a longitudinal study. *Journal of Documentation*, 57(1), 44-60.

VAKKARI, P. & HAKALA, N. (2000). Changes in relevance criteria and problem stages in task performance. *Journal of Documentation*, 56(5), 540-562.

VOORHEES, E.M. (1998). Variations in relevance judgements and the measurement of retrieval effectiveness. *In:* Croft, B.C. *et al. eds. Proceedings of the 21st Annual International ACM SIGIR Conference on Research and Development in Information Retrieval.* Melbourne, Australia, 1998. ACM Press, 315-323.

VOORHEES, E.M. (2000). Variations in relevance judgements and the measurement of retrieval effectiveness. *Information Processing and Management*, 36, 697-716.

VOORHEES, E.M. (2001). Evaluation by highly relevant documents. *In:* Croft, W.B *et al. eds. Proceedings of the 24th Annual International ACM SIGIR conference on Research and Development in Information Retrieval.* New Orleans, Louisiana, USA. ACM Press, 74-82.

WANG, P. (1997). Users' information needs at different stages of a research project: A cognitive view. In: Vakkari, P. *et al.* (eds). *Information Seeking in Context.* London: Taylor Graham, 307-318.

WELTY, C. & GUARINO, N. (2001). *Supporting ontological analysis of taxonomic relationships.* Institute for systems science and biomedical

engineering of the Italian Research Council (CNR). [Online]. Available http://www.labseb.pd.cnr.it/infor/ontology/papers/DKE-2001.pdf (13 March 2003).

WILSON, P. (1973). Situational relevance. *Information Storage and Retrieval*, 9, 457-471.

WILSON, T.D. (1999). Models in information behaviour research. *Journal of Documentation*, 55(3), 249-270.

YUANG, W. & MEADOW, C.T. (1999). A study of the use of variables in information retrieval user studies. *Journal of the American Society for Information Science*, 50(2):140-150.

APPENDIX A: QUESTIONNAIRES

This appendix shows the questionnaires used to gather empirical data in support of the relevance model.

There were three sections to the questionnaire:

Section A had to be completed once by each respondent and serves as a contextualisation of the work task.

Section B had to be completed for every document used to such an extent that it was included in the bibliography.

Section C had to be completed for every document retrieved and at least partially read, but not used to such and extent that it was included in the bibliography.

Section A:

General questions relating to your thesis/paper and the subject area
(This section must be answered once only, when the thesis/paper has been completed)

1. Are you completing this questionnaire with regard to

- ☐ Doctoral/Masters thesis
- ☐ Conference paper
- ☐ Journal article
- ☐ Other (please describe below)

_____

_____

2. Title of your thesis/paper:

_____

_____

3. What is the broad topic of your thesis/paper?

_____

_____

_____

_____

4. If you are completing this questionnaire with regard to a **thesis,** please answer **Question 4a.**
If you are completing this questionnaire with regard to a **conference paper**, please answer **Question 4b.**
If you are completing this questionnaire with regard to a **journal article,** please answer **Question 4c.**

4a. In what way do you think your thesis is relevant to this specific degree course?

- ☐ It deals with one or more of the identified topics of the course
- ☐ It is marginally relevant to the topic of the course, but deals with aspects that the audience should know about.
- ☐ It is an interesting new research topic in this field
- ☐ Other (Please specify below)

_____

_____

_____

4b. In what way do you think your conference paper is relevant to this specific conference?

- ☐ It deals with one or more of the identified topics of the conference
- ☐ It is marginally relevant to the topic of the conference, but deals with aspects that the audience should know about.
- ☐ It is an interesting new research topic in this field
- ☐ Other (Please specify below)

_____

_____

_____

4c. In what way do you think your article is relevant to this specific journal?

- ☐ It deals with one or more of the identified topics of the journal
- ☐ It is marginally relevant to the topics usually covered in the journal, but deals with aspects that the audience should know about.
- ☐ It is an interesting new research topic in this field
- ☐ Other (Please specify below)

_____

_____

_____

5. What type of thesis/paper are you writing? (Tick all relevant boxes)

- ☐ Literature review
- ☐ State of the art
- ☐ Empirical findings to support / disprove an established theory
- ☐ Application of theory to practice
- ☐ Modelling

6. What is the primary focus of your thesis/paper? (Tick one box only)

- ☐ Literature review
- ☐ State of the art
- ☐ Empirical findings to support / disprove an established theory
- ☐ Application of theory to practice
- ☐ Modelling

7. How would you judge your theoretical background knowledge of the subject?

a. Before you started writing the thesis?

- ☐ Very good
- ☐ Moderate to good
- ☐ Moderate to low
- ☐ Not good

b. When you finished the thesis?

- ☐ Very good
- ☐ Moderate to good
- ☐ Moderate to low
- ☐ Not good

8. At what level do you expect the knowledge of the audience to be regarding the subject of YOUR paper?

- ☐ Very good
- ☐ Moderate to good
- ☐ Moderate to low
- ☐ Not good

9. How do you think your approach to the topic will be received by the audience?

_____

_____

_____

_____

Section B:

Questions relating to documents which were used (as well as cited in your bibliography)

(This section must be completed for every document used when you wrote your paper)

For office use

Group number	V1		1-2
Respondent number	V2		3-4
Relevance code	V3	1	5
Document number	V4		6-8

1. Bibliographic details of document:

Title:
Author:
Source:

2. Why did you use this document (Tick all relevant boxes)

The retrieval engine gave it a high relevance ranking	30	V5		9-10
The topic of the document is very similar to the topic of my paper	31	V6		11-12
The viewpoint of this document supports my approach to the topic	28	V7		13-14
The viewpoint of this document is in accordance with the approach of the conference theme	26	V8		15-16
It was easy to obtain / I couldn't find anything else	5	V9		17-18
I know the work of this author	24	V10		19-20
Other reasons (Please explain below)		V11		21-22
		V12		23-24
		V13		25-26

3. How useful was this document to you?

Very useful	1	V14		27
Fairly useful	2			
Not really useful	3			

4. How important was this paper in the formulation of the focus of your research problem?

Very important	1	V15		28
Fairly important	2			
Not really important	3			

5. In what way was the document useful to you? (Tick all relevant boxes)				
It provided me with background information	1	V16		29-30
It provided me with detailed information	11	V17		31-32
It told me something I did not know	29	V18		33-34
It verified something I already knew	28	V19		35-36
It changed the focus of my paper	8	V20		37-38
It helped me to solve a problem	8	V21		39-40
It helped me to make a decision	7	V22		41-42
It is meaningful within the theme of the conference	26	V23		43-44
The viewpoint of this document has an interesting/unusual perspective on the conference theme	26	V24		45-46

6. The scope of this document, in terms of your paper/research is:				
Too wide	1	V25		47
About right	2			
Too narrow	3			

7. How would you rate the expertise (subject knowledge) of the author?				
An expert on the subject	1	V26		48
Has moderate to high knowledge of the subject	2			
Has moderate to low knowledge of the subject	3			
Has very little knowledge of the subject	4			

8. How do you feel about the viewpoint of the author as expressed in the document?				
I agree fully	1	V27		49
I agree with most of it	2			
I agree with some of it	3			
I don't agree at all	4			

9. With regard to the author: (please mark all the statements that are true)				
I am familiar with the author's work	1	V28		50
I know the author personally	2	V29		51
I have used this author's work before in my papers	3	V30		52
I will consider using this author's work again in future	4	V31		53

10. The viewpoint of this document will be viewed favourably by my peers				
Yes	26	V32		54
No	0			

11. The academic standard of this document will be viewed favourably by my peers				
Yes	26	V33		55
No	0			

12. This document conforms to my own academic standards				
Yes	28	V34		56
No	0			

13. I agree with the viewpoint of this document

Yes	1	V35	☐	57
No	2			

14. Did you ask any other person's opinion about the information content of this document?

Yes	26	V36	☐	58
No	0			

15. If you answered "yes" in question 14, did this person's opinion influence your view of the document?

Yes	26	V37	☐	59
No	0			

16. If you answered "yes" in question 15, please explain in what way your view was influenced:

	V38	☐☐	60-61
	V39	☐☐	62-63

17. With regards to the terminology used in this document: (Please mark all the statements that are true)

The terminology is known to me	7	V40	☐☐	64-65
The terminology was not known to me before I read this document	7	V41	☐☐	66-67
The terminology is similar to the terminology used in other documents in this field	19	V42	☐☐	68-69
I use the same terminology	28	V43	☐☐	70-71
I will consider using terminology introduced by this document in future	28	V44	☐☐	72-73

18. The font type used in the document

Was easy to read	1	V45	☐	74
Irritated or frustrated me	2			

19. The font size used in the document

Was easy to read	1	V46	☐	75
Irritated or frustrated me	2			

20. The layout used in the document

Was easy to read	1	V47	☐	76
Irritated or frustrated me	2			

21. The colours used in the document

Was easy to read	1	V48	☐	77
Irritated or frustrated me	2			
Not applicable	0			

22. The writing style used in the document -			
Was easy to read	1	V49 ☐	78
Irritated or frustrated me	2		
23. How important would you rate this particular document for your paper?			
I could not have completed my paper without this document	1	V50 ☐	79
I would have been able to complete my paper without this document, but it would have suffered in terms of quality	2		
I would have been able to complete my paper without this document with no difficulty	3		
24. At what stage of your research did you decide that this document might be useful?			
When I started my literature review	1	V51 ☐	80
When I started writing the paper	2		
Halfway through the writing process	2		
After I changed the focus of my paper	2		

Section C:

Questions relating to documents which were retrieved, obtained and at least partially read, but not used/cited in your paper

(This section must be completed for every document obtained and at least partially read, but not used or cited when you wrote your paper)

For office use

Group number	V1		1-2
Respondent number	V2		3-4
Relevance code	V3	2	5
Document number	V4		6-8

1. Bibliographic details of document:

Title:
Author:
Source:

2. How much of the document did you read before you decided that it was probably not useful?

Title, keywords and/or abstract	1	V5	9
Some parts of the document	2		
The entire document	3		

3. All documents in this section was not cited. However, some of them might have been useful to a certain degree. If the document was useful, but it was not cited, please answer 3a and 3b. If you read the document or parts of the document and it was not useful at all, please answer 3b only.

3a. The document was useful in the following way(s): (Please tick all applicable boxes)

It provided me with theoretical background for my topic, or it provided me with an overview / state of the art of this particular topic	1	V6	10-11
It had a similar theoretical viewpoint to my own paper	28	V7	12-13
The author has an interesting, but different approach to the problem	26	V8	14-15
It provided me with a particular focus / approach to my own paper	11	V9	16-17
Not applicable	0	V10	18

3b. Why did you not use the document? (Tick all applicable boxes)				
The topic of the document is very different from the topic of my paper	26	V11		19-20
The document taught me nothing new	29	V12		21-22
The document provided a good overview, but was too elementary/superficial to be cited in a scholarly paper	1	V13		23-24
The viewpoint of this document does not support my approach to the topic	28	V14		25-26
I could not use the information in the document in a meaningful way	8	V15		27-28
The viewpoint of this document is not in accordance with the conference theme	26	V16		29-30
I am not familiar with the work of this author	16	V17		31-32
Someone else had read the document and commented negatively on it	17	V18		33-34
It was not cited in any other document	17	V19		35-36
I read another document that commented negatively on this one	17	V20		37-38
Other reasons (please explain below)		V21		39-40
		V22		41-42

4. The scope of this document, in terms of your paper/research is:				
Too wide	1	V23		43
About right	2			
Too narrow	3			

5a. Did you need hard facts, graphs or statistics?				
Yes	1	V24		44
No	2			

5b. If yes, did the document provide any of these?				
Yes	1	V25		45
No	2			
Not applicable	3			

6. How would you rate the quality of the document?				
High	1	V26		46
Medium	2			
Low	3			

7. How would you rate the currency of the document?				
Current	1	V27		47
Old, but still valid	2			
Outdated	3			

8. How would you rate the accuracy of the document?				
High	1	V28		48
Medium	2			
Low	3			

9. How would you rate the expertise (subject knowledge of the author?

An expert on the subject	1	V29	49
Has moderate to high knowledge of the subject	2		
Has moderate to low knowledge of the subject	3		
Has very little knowledge of the subject	4		

10. How do you feel about the viewpoint of the author as expressed in the document?

I agree fully	1	V30	50
I agree with most of it	2		
I agree with some of it	3		
I don't agree at all	4		

11. With regard to the author:
(please mark all the statements that are true)

I am familiar with the author's work	1	V31	51
I know the author personally	2	V32	52
I have used this author's work before in my papers	3	V33	53
I will consider using this author's work again in future	4	V34	54

12. The viewpoint of this document will be viewed favourably by my peers

Yes	26	V35	55
No	0		

13. The academic standard of this document will be viewed favourably by my peers

Yes	26	V36	56
No	0		

14. This document conforms to my own academic standards

Yes	28	V37	57
No	0		

15. I agree with the viewpoint of this document

Yes	27	V38	58
No	0		

16. Did you ask any other person's opinion about the information content of this document?

Yes	26	V39	59
No	0		

17. If you answered "yes" in question 16, did this person's opinion influence your view of the document?

Yes	26	V40	60
No	0		

18. If you answered "yes" in question 17, please explain in what way your view was influenced:

	V41		61-62
	V42		63-64

19. With regards to the terminology used in this document: (Please mark all the statements that are true)

The terminology is known to me	7	V43	65-66
The terminology was not known to me before I read this document	7	V44	67-68
The terminology is similar to the terminology used in other documents in this field	19	V45	69-70
I use the same terminology	28	V46	71-72
I will consider using terminology introduced by this document in future	28	V47	73-74

20. The font type used in the document

Was easy to read	1	V48	75
Irritated or frustrated me	2		

21. The font size used in the document

Was easy to read	1	V49	76
Irritated or frustrated me	2		

22. The layout used in the document

Was easy to read	1	V50	77
Irritated or frustrated me	2		

23. The colours used in the document

Was easy to read	1	V51	78
Irritated or frustrated me	2		
Not applicable	0		

24. The writing style used in the document -

Was easy to read	1	V52	79
Irritated or frustrated me	2		

25. At what stage of your research did you decide that this document might be useful?

When I started my literature review	1	V53	80
When I started writing the paper	2		
Halfway through the writing process	2		
After I changed the focus of my paper	2		

APPENDIX B: COVER LETTER & LETTER OF INFORMED CONSENT

This appendix shows the cover letter and the letter of informed consent that had to be signed by all participants, as required by the Ethics Committee of the University of Pretoria.

Questionaire

Instructions:

- Mark the tick-box next to the appropriate answer as shown in the example below:

Who is the president of Zimbabwe?

Nelson Mandela	
Robert Mugabe	X
Jacob Zuma	

- Please provide a written response if lines are provided below the question.

Please note:

Sometimes a question might contain the phrase "conference theme" or "theme of the conference". If you are

- an undergraduate student, please read this as "topic of my assignment",
- a masters or doctoral student, please read this as "topic of my thesis/dissertation".

Thank you for your participation.

Consent form

Researcher

I, the undersigned Erica Cosijn have fully explained to the research participant the nature and purpose of the research for which I have asked his/hers participation.

Research participant

I, the undersigned _____ understands that my participation in this research is voluntary and that my responses will be treated as confidential if I so wish. I may at any time and for any reason withdraw my participation.

Researcher _____

Research participant (not compulsory) _____

Witness _____

Place _____

Date _____

APPENDIX C: DEGREES OF RELEVANCE WITHIN WORK TASK

This appendix shows a detailed table of reasons for use/usefulness by work task and degree of usefulness as discussed in Section 5.2.3.

Table C.1. Reasons for use/usefulness by work task and degree of usefulness

Reasons for use/usefulness of documents	Masters and Doctoral theses			Conference papers and journal articles			Class assignments		
	Very useful	Fairly useful	Not really useful	Very useful	Fairly useful	Not really useful	Very useful	Fairly useful	Not really useful
Retrieval engine gave it a high relevance ranking	63.79	31.03	5.17	88.89	11.11	0.00	50.00	38.89	11.11
The topic of the document is very similar to the topic of my paper	46.25	37.50	16.25	91.43	8.57	0.00	47.83	47.83	4.35
The viewpoint of this document supports my approach to the topic	64.65	31.31	4.04	55.36	44.64	0.00	38.46	53.85	7.69
The viewpoint of this document is in accordance with the approach of the conference theme	33.33	66.67	0.00	81.82	18.18	0.00	33.33	60.00	6.67
It was easy to obtain / I couldn't find anything else	20.69	44.83	34.48	60.00	40.00	0.00	25.00	62.50	12.50
I know the work of this author	61.76	32.35	5.88	40.63	53.13	6.25	0.00	75.00	25.00
It provided me with background information	39.29	41.07	19.64	53.33	31.67	15.00	37.50	50.00	12.50
It provided me with detailed information	77.65	21.18	1.18	79.49	20.51	0.00	53.57	42.86	3.57
It told me something I did not know	55.70	32.91	11.39	70.59	29.41	0.00	37.50	53.13	9.38
It verified something I already knew	49.33	40.00	10.67	54.55	45.45	0.00	31.25	62.50	6.25
It changed the focus of my paper	85.71	0.00	14.29	100.00	0.00	0.00	50.00	50.00	
It helped me to solve a problem	81.82	15.91	2.27	66.67	26.67	6.67	38.10	47.62	14.29
It helped me to make a decision	74.55	18.18	7.27	50.00	50.00	0.00	45.00	45.00	10.00
It is meaningful within the theme of the conference	40.00	60.00	0.00	47.62	52.38	0.00	33.33	58.33	8.33
The viewpoint of this document has an interesting/unusual perspective on the conference theme	66.67	33.33	0.00	33.33	66.67	0.00	40.00	60.00	0.00

APPENDIX D: RELEVANCE TYPES BY WORK TASK

Appendix D contains a summary table of relevance types by work task where the detail information in Tables 5.3 and 5.4 have been summarised as categorised by relevance type. A graphic representation of this table is also presented in Appendix D.

Table D.1. Relevance types by work task

Value	Description	Relevance type	Masters and Doctoral theses N=347	Conference papers and journal articles N=181	Class assign-ments N=95
24	Emotional response w.r.t. author	Affective	10.09	19.89	4.21
27	Emotional response w.r.t. viewpoint congruence	Affective	0.00	1.10	0.00
	Affective relevance judgements		**10.09**	**20.99**	**4.21**
30	Machine matching - algorithmic	Algorithmic	16.71	9.96	18.95
	Algorithmic relevance judgements		**16.71**	**9.96**	**18.95**
1	Background or specific information	Cognitive	1.15	0.55	0.00
11	Real needs - Proven information, hard data, facts, figures	Cognitive	3.17	1.66	0.00
28	Supports current state of knowledge	Cognitive	28.82	30.94	27.37
29	Enhances current state of knowledge	Cognitive	0.29	0.00	0.00
	Cognitive relevance judgements		**33.43**	**33.15**	**27.37**
2	Sufficient detail/depth	Situational	0.00	2.21	0.00
5	Accessible/available within worktask situation	Situational	8.36	2.76	8.24
10	Current in terms of work task	Situational	0.29	0.00	0.00
12	Situation - Proven information, hard data, facts, figures	Situational	0.29	0.00	0.00
16	Author's expertise in terms of situation	Situational	0.29	0.00	0.00
18	Usefulness of format for work task	Situational	0.86	1.10	1.05
	Situational relevance judgements		**10.09**	**6.07**	**9.29**
4	Acceptable/suitable in socio-organizational environment	Socio-cognitive	3.46	3.31	0.00
17	Author's expertise in socio-organization environment	Socio-cognitive	0.58	0.00	0.00
19	Format/presentation - Socio-organizational acceptance	Socio-cognitive	0.86	0.00	0.00
23	Quality - socio-organizational acceptance	Socio-cognitive	0.29	1.10	0.00
26	Consistent with or supported by others in the field	Socio-cognitive	1.44	6.08	15.79
	Socio-cognitive relevance judgements		**6.63**	**10.49**	**15.79**
31	Aboutness	Topicality	23.05	19.34	24.21
	Topical relevance judgements		**23.05**	**19.34**	**24.21**

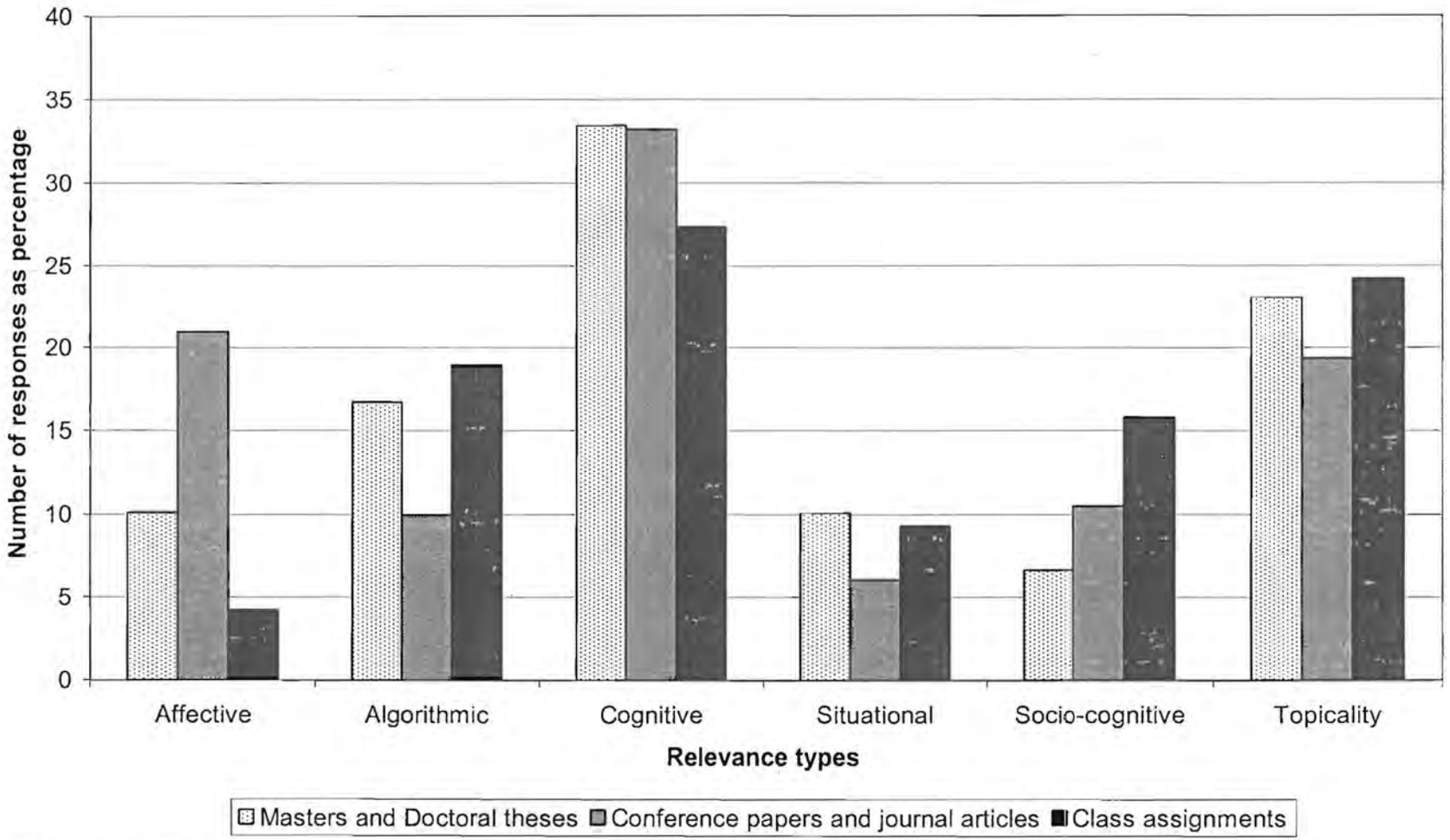

Figure D.1. Type of relevance judgements by work task

APPENDIX E: RELEVANCE JUDGEMENTS BY TASK TYPE

Appendix E contains the detailed table of relevance judgement by task type as discussed in Section 5.2.4 and represented in Table 5.5.

Table E.1. Relevance judgements by task type – documents cited

Relevance Type	Statistical analysis			
	Row details	Search task	Work task	Total
Affective	Frequency	49	28	**77**
	Expected freq	47.015	29.985	-
	Percent	9.26	5.29	**14.56**
	Row percent	63.64	36.36	-
Cognitive	Frequency	127	75	**202**
	Expected freq	123.34	78.662	-
	Percent	24.01	14.18	**38.19**
	Row percent	62.87	37.13	-
Situational	Frequency	24	31	**55**
	Expected freq	33.582	21.418	-
	Percent	4.54	5.86	**10.40**
	Row percent	43.64	56.36	-
Socio-cognitive	Frequency	31	26	**57**
	Expected freq	34.803	22.197	-
	Percent	5.85	4.91	**10.78**
	Row percent	54.39	45.61	-
Topical	Frequency	92	46	**138**
	Expected freq	84.261	53.739	-
	Percent	17.39	8.70	**26.09**
	Row percent	66.67	33.33	-
Total	Frequency	**323**	**206**	**529**
	Percent	**61.06**	**38.94**	**100.00**

APPENDIX F: THE IMPACT OF SOCIO-COGNITIVE RELEVANCE CONSIDERATIONS ON DOCUMENT USE

Appendix F contains the detailed table of the impact of socio-cognitive relevance considerations on document use, showing the relative percentages not indicated in Table 5.14.

Table F.1. The impact of socio-cognitive relevance considerations on document use

Description of variable	The academic standard of the document will be viewed favourably by my peers			Total %
	N	Yes %	No %	
This paper was very important in the formulation of your research problem	104	32.50	0.00	32.50
This paper was fairly important in the formulation of your research problem	151	43.13	3.75	47.19
This paper was not really important in the formulation of your research problem	65	17.19	3.13	20.31
Total	**320**	**92.81**	**6.88**	**100.00**
The document is meaningful with the conference theme **Total**	**38**	**97.37**	**2.63**	**100.00**
The viewpoint of this document has an interesting/unusual perspective on the conference theme **Total**	**20**	**75.00**	**25.0**	**100.00**
I agree fully with the viewpoint of the author	129	40.00	0.31	40.31
I agree with most of the viewpoint of the author	159	46.25	3.44	49.69
I agree with some of the viewpoint of the author	31	6.25	3.13	9.69
I don't agree with the viewpoint of the author at all	1	0.31	0.00	0.31
Total	**320**	**92.81**	**6.88**	**100.00**
I am familiar with the author's work **Total**	**144**	**95.14**	**4.86**	**100.00**
I know the author personally **Total**	**47**	**97.87**	**2.13**	**100.00**
I have used the author's work before in my papers **Total**	**97**	**97.94**	**2.06**	**100.00**
I will consider using the work of this author again **Total**	**233**	**95.71**	**4.29**	**100.00**
The terminology is similar to the terminology used in other documents in this field **Total**	**222**	**93.24**	**6.76**	**100.00**
I could not have completed my paper without this document	96	29.69	0.31	30.00
I would have been able to complete my paper without this document, but it would have been difficult	145	43.44	1.87	45.31
I would have been able to complete my paper without this document with no difficulty	79	19.69	4.69	24.69
Total	**320**	**92.81**	**6.88**	**100.00**