

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 describes [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."¹¹ 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 foregoing 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 <i>relation</i> between:	Criterion for "success"
System / Algorithmic Relevance	Query <i>and</i> information objects (texts)	Comparative effectiveness in inferring relevance
Topical / Subject Relevance	Subject or topic expressed in a query <i>and</i> subject or topic covered by information objects	Aboutness
Cognitive Relevance / Pertinence	State of knowledge and cognitive information need of the users <i>and</i> information objects	Cognitive correspondence, informativeness, novelty, information quality
Situational Relevance / Utility	Situation, task or problem at hand <i>and</i> 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 <i>and</i> 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

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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	Interpretation 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 modification	Relevance judgements are content dependent	Relevance judgements are content, feature, form & presentation dependent	Including interaction <i>with</i> environment	Including interaction <i>within</i> 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.

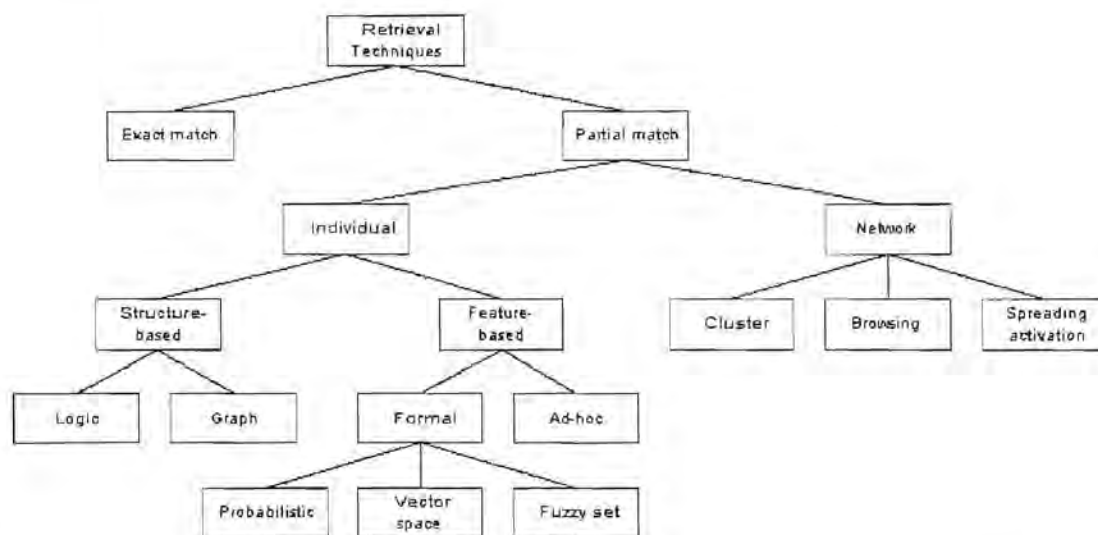


Figure 3.1. A classification of matching methods (redrawn from Belkin & Croft, 1987)

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 be 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 $rel(\text{Information}, RIN, f(t), \{\text{Topic}, \text{Task}, \text{Context}\})$, 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).

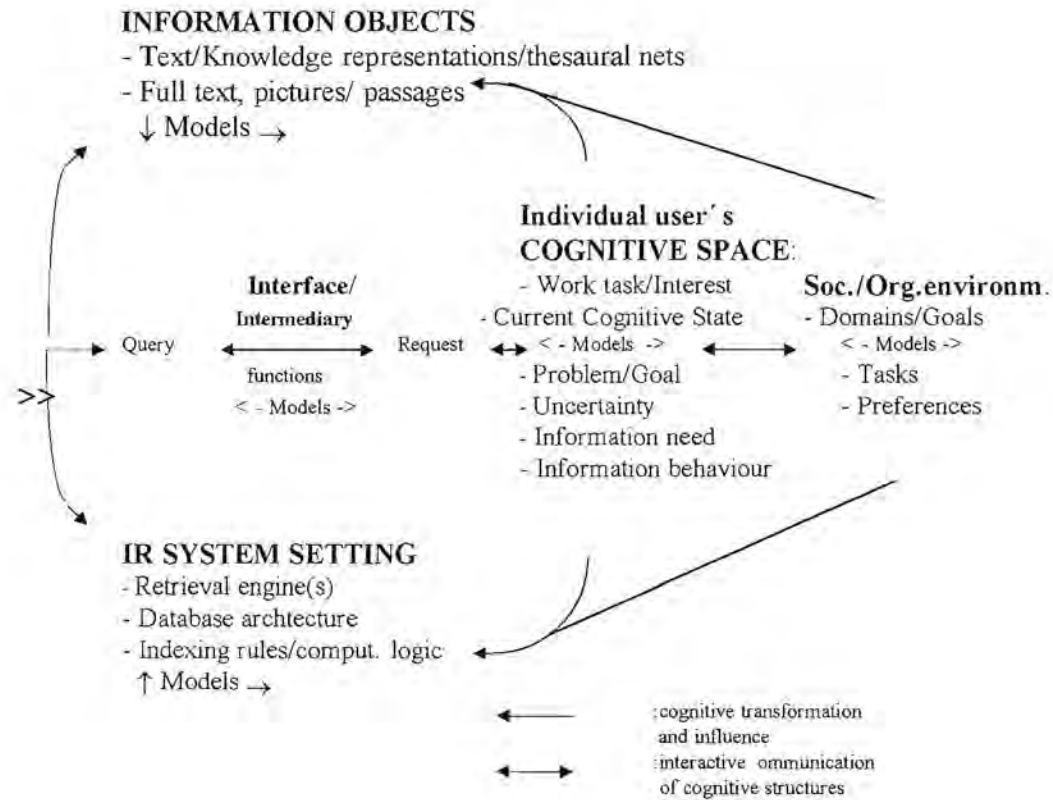


Figure 3.2. Cognitive model of information transfer (Ingwersen, 1996)

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.

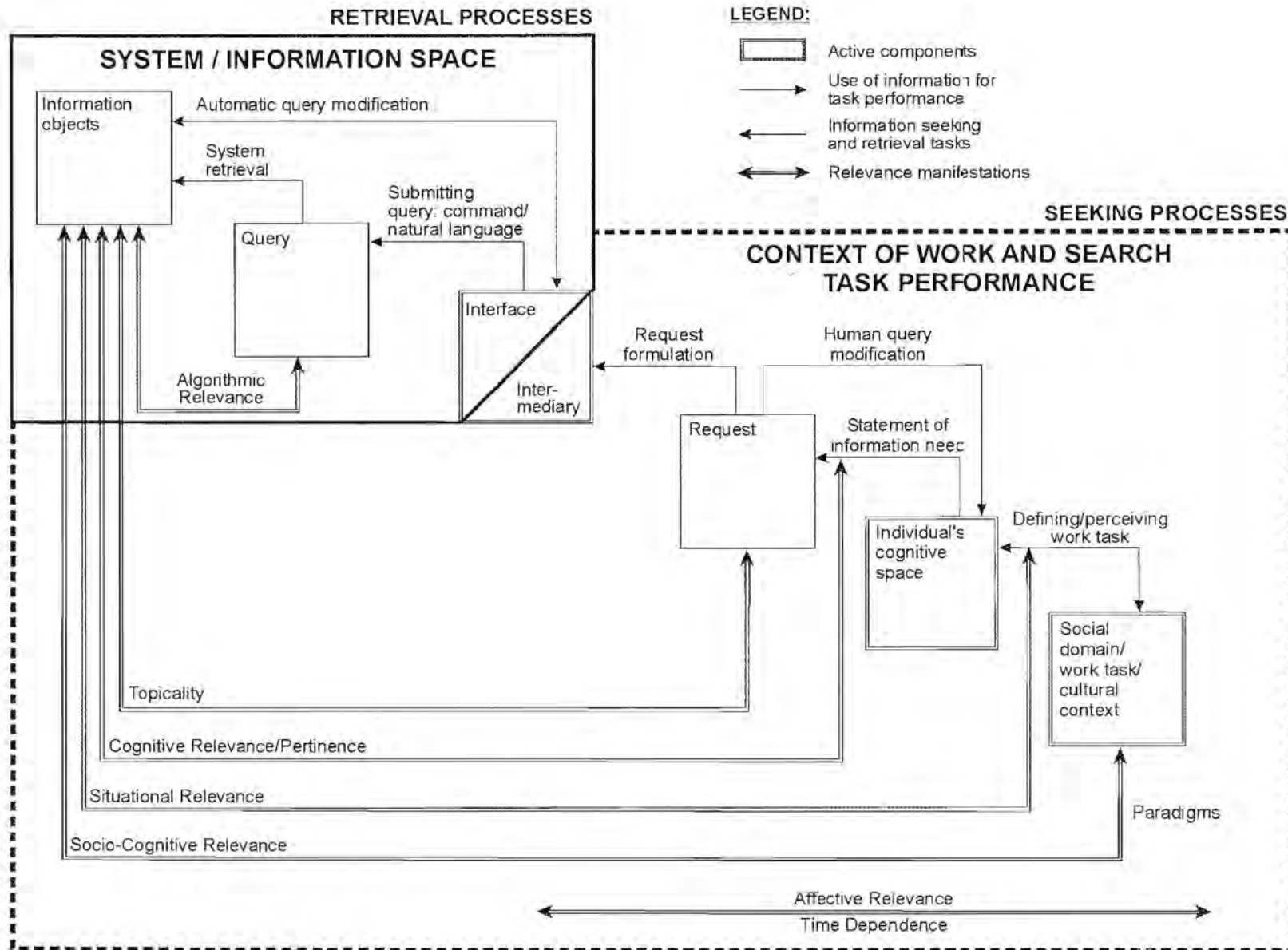


Figure 3.3: Interactive Information Retrieval: Work task performance, search task performance and relevance types

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.