# Context in information interaction – revisited 2006

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*The paper discusses and illustrates in detail the configurations of contexts involved in information interaction and retrieval (IIR). It builds on ideas and initial explorations published by Ingwersen & Järvelin (2004; 2005). Information retrieval (IR) is modelled in a holistic framework, which emphasises five central cognitive components or (group of) actors and their mutual interaction and influence. This generalised framework gives rise to six nested kinds of context, with the narrowest elements (the core) being signs in the context of intra-object sign structures. Objects themselves are interrelated by an inter-object context and embedded in an interactive, often session-based context of activity and communication between several framework components, for instance, between individual components or features like searcher or IR system interface and more collective components like information space, socio-organisational structures, preferences and domains, cultural traditions, as well as daily life and work tasks. Finally, societal, economic and technical infrastructures act as remote contexts. The historic context (i.e. the experiences of the past concerning documents, work and search task execution, information sources and IR systems that create expectations with respect to the information situation at hand) influences all other contexts as a seventh category. The paper discusses three special configurations of the generalised framework for contexts in IIR: when the core – or focus of analysis – represents (a) information objects; (b) searchers of information; or (c) the social and cultural context itself. For each different role of the core – or research focus – the remaining types of context in the framework are altered, providing new clues as to which features of IIR one should focus on during investigations.*

## 1. Introduction

In Ingwersen & Järvelin (2004; 2005), the integration of perspectives and models of information seeking and information retrieval (IS&R) became anchored to a holistic social-cognitive conceptual framework for research. Epistemologically it is based on elements of the cognitive theory for information interaction and retrieval (IIR) put forward by Ingwersen (1992; 1996; 2001). Intentionality in the form of perceived work or non-job-related daily life tasks or interests, and search tasks, is central as the rationale underlying IIR. Search tasks are the instrumental means of the cognitive-emotional as well as physical nature that serves to advance the fulfilment of the work task or interest in terms of information provision (Ingwersen & Järvelin, 2005: 285-287).

According to Ingwersen & Järvelin (2004: 301), the research framework reflects the understanding that IS&R are processes of cognition (and emotion) for the information seeking actor(s) or team *in context* (Figure 1).
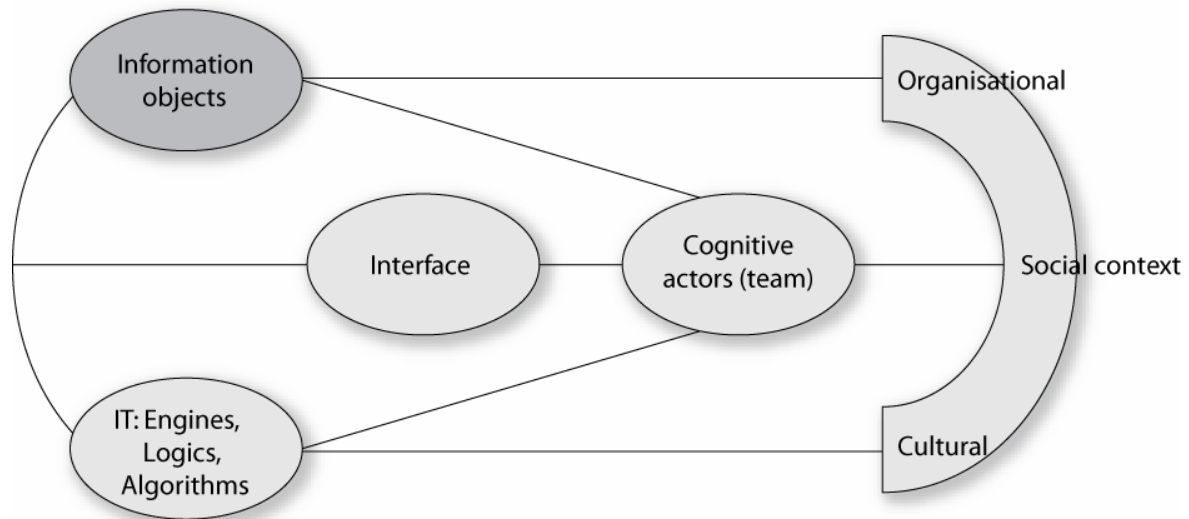


**Figure 1: General model of information seeking and (interactive) information retrieval**
*Source:* Simplistic version of Ingwersen & Järvelin (2005: 261).
*Note:* Lines refer to kinds of interaction or one-way influence.

In its most simplistic form, the framework consists of five major components that are interconnected by communicative behaviour, including interaction. On the left-hand side the framework models the representations of information space in the form of information objects (or documents in a broad sense) interacting with an information technology (IT) platform, such as one or several search engines. Including the interface component, this portion of the framework signifies what is named the *systemic context* to the information searcher's component.

To the right of the searcher(s) the framework consists of the *sociocultural-organisational context* at play during the current situation – see the collapsed framework in Figure 2. In the latter component we find the real life work tasks as well as non-job-related tasks or interests, and other central features that influence the seeking actors who, during (social) interaction, make perceptions of such phenomena.

Essentially, each framework component is contextual to any other component. This implies, for instance, that searchers are contextual to (influencing) interfaces and information systems as well as to the social environment – mainly via kinds of interaction, such as retrieval (left) or social interaction between human actors (right). By manifestations of practice and authorships, the sociocultural and organisational environment over time influences the information objects on the one hand and the IT platform on the other.

It also implies that one cannot (or should not) simply observe one component in isolation, but make such investigations in context of the neighbouring framework components. The types of context that come into play during IIR are discussed below. In

particular, this paper explores a revised extended version of the *nested model of contexts,* which derives from the research framework depicted in Figure 1 and published in Ingwersen & Järvelin (2004: 305; 2005: 281).
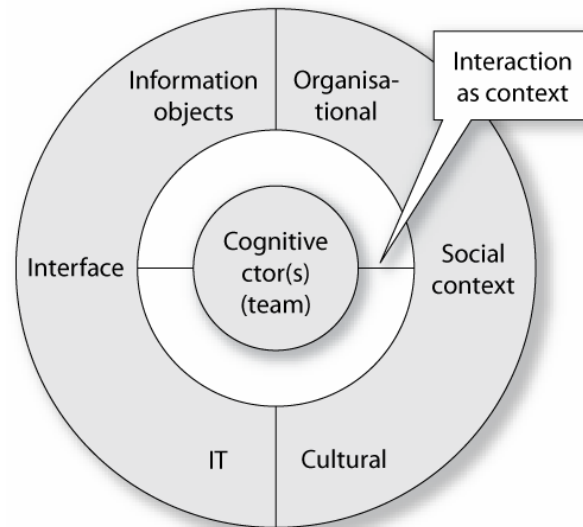


Figure 2: The circle of systemic (left) and sociocultural and organisational (right) contexts in IIR

The paper is organised as follows. First, there is a brief discussion of different kinds of general context models in information behaviour, information seeking and IIR. A section on why context is central to the understanding of knowledge acquisition follows and the revised stratified model of contexts for IIR is outlined. The next section discusses three different configurations of the nested model, and the contribution concludes by pointing to the central facets of context.

## 2. General models of context in information behaviour

Wilson (1999) demonstrated several rather detailed models of information behaviour, information seeking and information retrieval (IR). Generally speaking, he views the three processes as nested within one another – like the layers of an onion. IR (to him: information searching) is the most narrow process in the context of seeking and information behaviour. The latter circumscribes information processes, such as communication, management and the use or production of information.

### 2.1 The traditional attitude towards context

Commonly, research on information operates with two kinds of context. One is the traditional "social context" for searchers – in our framework expanded by cultural and organisational features – which information-seeking studies make use of intensively and which increasingly becomes of interest to human-computer interaction and algorithmic IR research.

The second traditional meaning of "context" refers to information objects, their contents and interrelationships. This sense of context is essential to computer science and algorithmic IR for reasons of automatic indexing, and to scientometrics/webometrics for

reasons of citation and link analyses and mapping of science. The former makes use of an increasing volume of *intra-document* features, such as words in context of phrases in context of sentences in context of paragraphs, and so on. The latter also utilises *inter-document* features such as references (and citations) referring to other scientific work, keywords found in and connecting two or more documents, or hyperlinks. All kinds of representation may indeed form the backbone of inter-information object relationships, such as authors, journals, and colour or form in multimedia.

According to Ingwersen & Järvelin (2004: 304), however:

> Context is not only a searcher phenomenon. The system itself can (learn to) be context-aware in use. Interacting with searchers [Figure 1] means more to the system than capturing simple input data. Rather, temporal searcher interaction with a system forms a rich network of potential information regarding preferences, style, experience and knowledge, as well as interests.

This information helps constitute a *context of interaction* (or session activity) (dimension 3 in Figure 3) that can be made available for the system to help it interpret current searcher actions (Ruthven et al., 2003). As such, this context of interaction forms the backbone of data or features to be applied in recommender systems and architectures for personalised information systems.
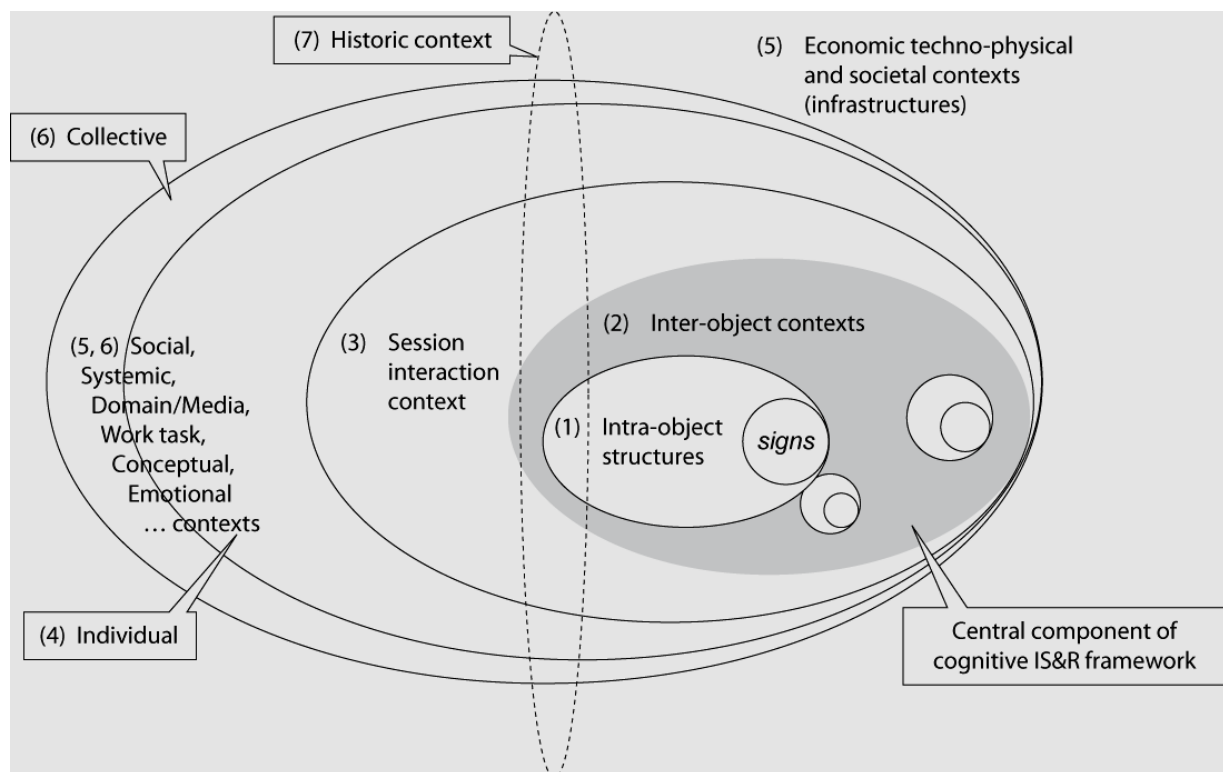


Figure 3: Nested general model of context stratification for IIR
*Source:* Revision of Ingwersen & Järvelin (2004; 2005).

## 2.2 Why is context important?

Ergonomic behaviour (like computer mouse or eye movements), patterns of relevance feedback or other *evidence* of the immediate perceptions and interpretations by the searcher constitute the interactive session context, with the seeking actor's current situations in a social context as more remote contextual phenomena (dimension 5 in Figure 3). The latter may be manifestations of cultural conventions, organisational preferences, or domain-specific traditions. For IR systems design it is crucial to uncover as many patterns of objective, *tangible* evidence as possible of actors' interpretations, as well as of the socio-organisational or cultural context itself.

Without such tangible evidence the system cannot react properly during session time. Evidence that represents features of documents, actors and their interactive behaviour, and the surrounding environment may contribute to narrowing down the multitude of possible tracks and pathways that a particular search may or could take. This is particularly important when information searchers initially provide very few clues of their information problem or task at hand – as is often observed in bibliographic online and Web IR. Capturing relevant contextual evidence is mandatory for IIR systems design – as is its *interpretation*. Hence the interdependence of research knowledge gained from field experiments of IIR and knowledge resulting from algorithmic IR – with the former providing clues to the latter for setting up workable query modification and alternative exploratory search algorithms.

Similarly, searchers rely on tangible evidence from systems, objects and interfaces in order to make valid interpretations of the output from search engines. Thus, there exists a mutual benefit and interdependence between the different kinds of evidence that represent types of context in IIR. Systems design and evaluation cannot be done effectively in isolation from contextual factors (Ingwersen & Järvelin, 2005).

## 3. Dimensions of context in IR – the general model

According to Ingwersen & Järvelin, (2004: 306; 2005: 281) and in line with the outline above:

> … for each component of the cognitive research framework [Figure 1] there exist representative objects that are media dependent. Such objects are, for instance, software entities in the IT component and interface, or the documents (information objects) in the information space. Within each object a range of contextual elements exists: the *intra-object* structures [dimension 1 in Figure 3]. For instance, in the IT component the lines of programming form such structures, as do the variety of cognitive structures in the searcher's mind. Within information objects images are contextual to a surrounding text or other structures attached to them, and vice versa. Paragraphs serve as contexts for their own sentences and words; signs are seen in the context of sign structures.

The nature of the core component selected from the research framework determines the characteristics of all remaining contexts in the model (Figure 3). There exist inter-object structures, as in context dimension 2 of Figure 3. In addition, four other nested levels of

context exist (dimensions 3-6). With reference to Ingwersen & Järvelin (2004: 307), the distinct stratification of the model is defined as follows:

1. *Intra-object* contexts in the model – signs in context of sign structures or elements constituting objects; that is, identifying the central research framework component (the research focus or core of the nested set of contexts of the model).

2. *Inter-object* structures of the central component, such as social networking, hyperlinks or citations between documents.

3. The *session context* dealing with features (evidence) of the interaction (or activity) between the central component of the research framework and other components or actors – with the situation at hand as a central cognitive-emotional element. Session context is embedded in broader seeking and information behaviour. The situation at hand is constructed by the actor's perception of (non-) job-related work and search tasks, the knowledge gap, potential sources, and so on (Ingwersen & Järvelin, 2005: 278). Session interaction is placed in the context of s*ocial, systemic, domain* and *work task contexts* – depending on the nature of the core component.

4. An *individual* conceptual and emotional context (actor: searcher; author); and systemic (engine; interface; information object) and domain properties immediately surrounding the core actor or component (work task; interest; preference; product).

5. A *collective* conceptual and emotional context (actors: search teams; author groups); systemic (networks; meta-engines; information objects; information space); and sociocultural and organisational structures in local settings.

6. *Techno-economic-politico-societal infrastructures* influencing (not necessarily always in a remote way) all actors, components and interactive sessions.

7. The *historic context* operating across this stratification; that is, the history of *all* participating actors' experiences, forming their expectations. All IIR processes and activities are under the influence of this temporal form of context.

## 3.1 Configurations of the contextual model – information space as the central component

In the case of information objects being the framework component in focus (Figure 3), we observe a change in the entire context configuration (Figure 4). This new configuration signifies which set of variables to concentrate on during investigation, because the (new) nearest neighbouring contexts provide such central variables. This is outlined and discussed in detail by Ingwersen & Järvelin (2005: 313-376).

Within and among information objects, the variety of representations of contents and relationships of signs (and sign structures) is central to any investigation of information space. If isolated, these representations form a limited and inadequate set of evidence for IIR purposes. By including in the neighbouring context, however, the interactive seeking/retrieval session, the information objects, their content, relationships and associative structures become value-added. This can most easily be observed in recommender systems (such as IR or advertisement systems) in which session evidence derived from objects plays a central role.
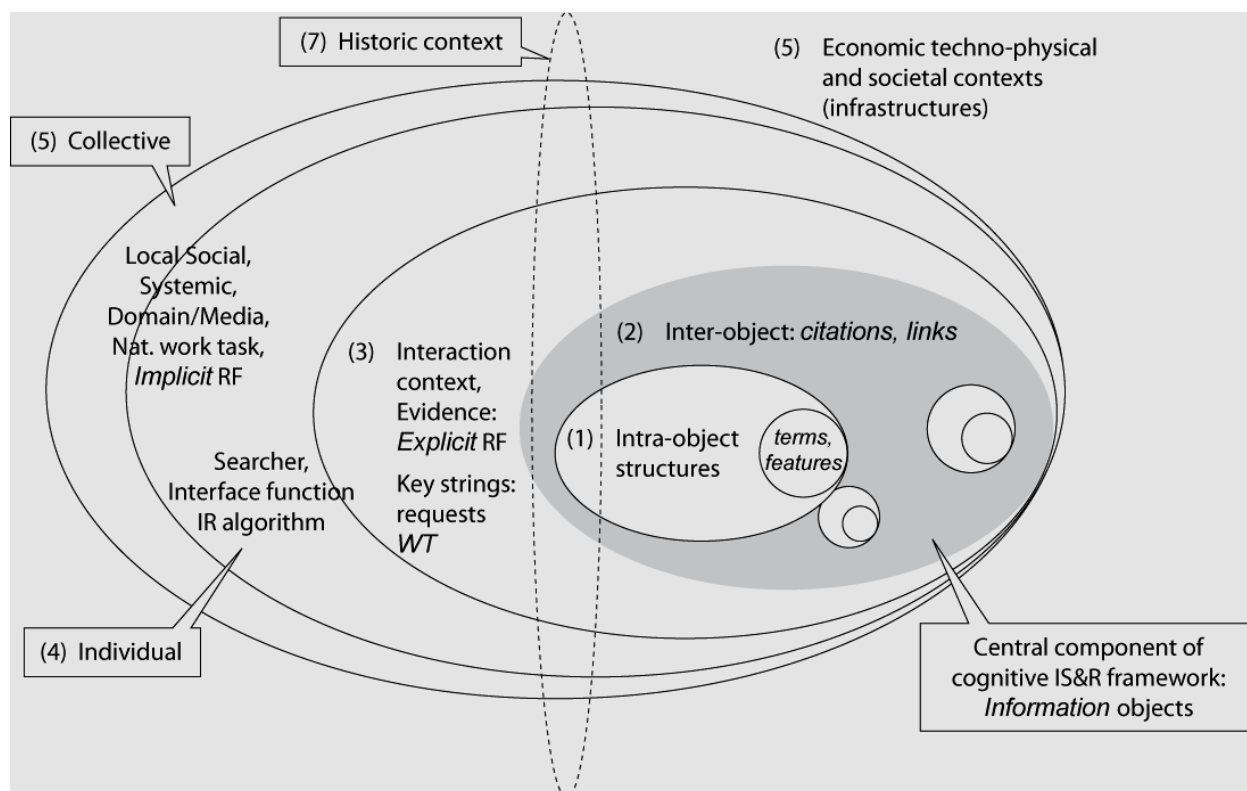
Figure 4: Nested model of context stratification for IIR – centred on information objects

The six sets of nested context dimensions now look like this:

1. *Intra-object structures:* Terms, phrases, image features, pixels, sentences …

2. *Inter-object contexts:* Links, citations, the clusters defined of various features …

3. *Interaction (session):* Search/authoring process *evidence*, such as eye/mouse movements, work task descriptions, explicit relevance feedback, search task path, features of algorithmic processes, auto-indexing keys, strings …

4. Component-dependent *individual* context (conceptual-emotional): Actor, current work task perception; conceptual: engine logic/algorithms; interface functionality …

5. Central component-dependent *collective* context: (Local) socio-organisational structures/conditions: domain vocabulary, natural work tasks, time constraints, organisational preferences, several searchers' work task perceptions, implicit relevance feedback behaviour; (local) systemic conditions …

6. *Infrastructural contexts:* Network type, speed, censorship, economic constraints …

(As seen in Figure 3, the historic context influences all the other dimensions of context.)

Taking recommender systems (or traditional public libraries) as examples, evidently objective relevant recommendations (or retrieval) can be directly hampered locally by technological infrastructures (context 6, for example network availability; use; cost) or by filtering (political correctness) and censorship (religion; current cultural ethics). Such

phenomena are thus represented by direct tangible evidence, although they seem far remote from the focus of investigation, namely the information space.

The shape of the nested model (Figure 4) resembles the onion model, depicting the cognitive systems engineering advocated by Rasmussen et al. (1994). That model emphasised the unification of the work domain (parts of context 5) and the user characteristics (context 4) for systems design (contexts 1-2). Session features and evidence (context 3) played insignificant roles (e.g. in terms of relevance feedback) in that model.

Typically, mainstream IR research as well as classification research has focused on context 1 in isolation, with natural language processing attempting to include context dimension 2. IR research has, in addition, tested the IT part of context 4 − only in the context of single documents (context 1). Information-seeking behavioural studies have mainly looked into the relationship between contexts 4 and 5, sometimes involving the infrastructure (context 6) and/or the historic context 7. Interactive IR and Web IR look into contexts 2-4, but generally avoid the nature of information objects themselves (context 1) and the local environment (context 5).

## 3.2 The searcher(s) as the central component

With the searcher(s) as the research focus, according to Ingwersen & Järvelin (2004: 308), interaction consists of social as well as interactive retrieval and communication activities. Each searcher may well work in teams (Hyldegård, 2005) and the attempts are to unveil by investigation their emotional, cognitive and social characteristics (contexts 1-2) in order to establish some kind of general evidence to be used in the design of information systems.

Naturally, the interplay between IR systems and searchers − session 3 − plays a central role in such human-computer interface studies and experiments (Ruthven et al., 2003). It is important to take into account not only the single retrieval systems and interface during IIR (part of context 4), but also the information objects (4-5) and even other seeking collaborative actors dealing with similar IR phenomena over time (e.g. in the past − the historic context). Evidence from the organisational environment (context 5) may typically be real work tasks or collected evidence on relevance feedback behaviour in a selected organisational culture, for example basic researchers' relevance feedback vs clinical researchers' relevance feedback behaviour (Nielsen, 2002). In developing countries the (lack of) physical or political infrastructure may very well influence negatively or prohibit the activities of the searcher for information (Dick, 2005).

## 3.3 The sociocultural and organisational setting as the core component

When concentrating on the social, cultural and/or organisational context of the research framework (Figure 1), the interaction (context 3) consists of formal or informal social interaction between individuals (or teams) acting as searchers, communicators or creators (context 4), and representatives for the units constituting the organisation (or culture) in question (contexts 1-2).

The organisational and/or sociocultural units correspond to the elements of the particular structural setting. It is within, or in, the communication processes between those units
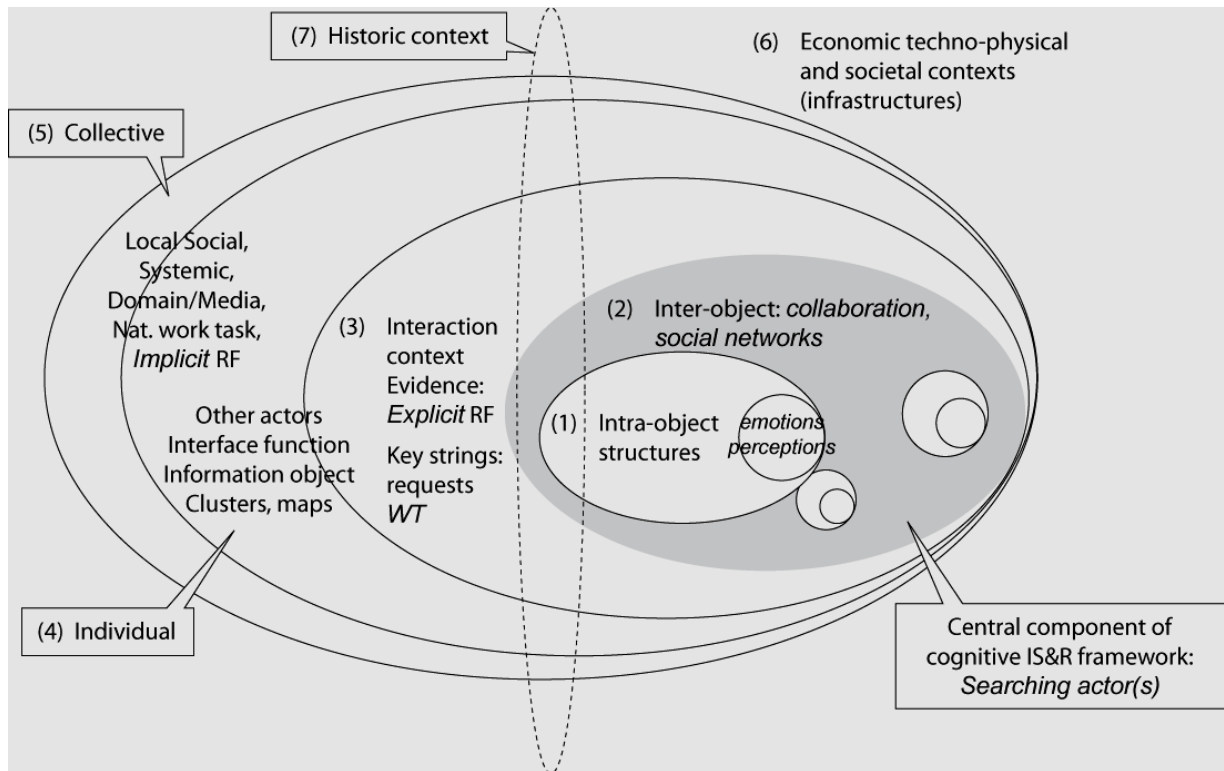
Figure 5: Nested model of context stratification for IIR – centred on the searcher(s)
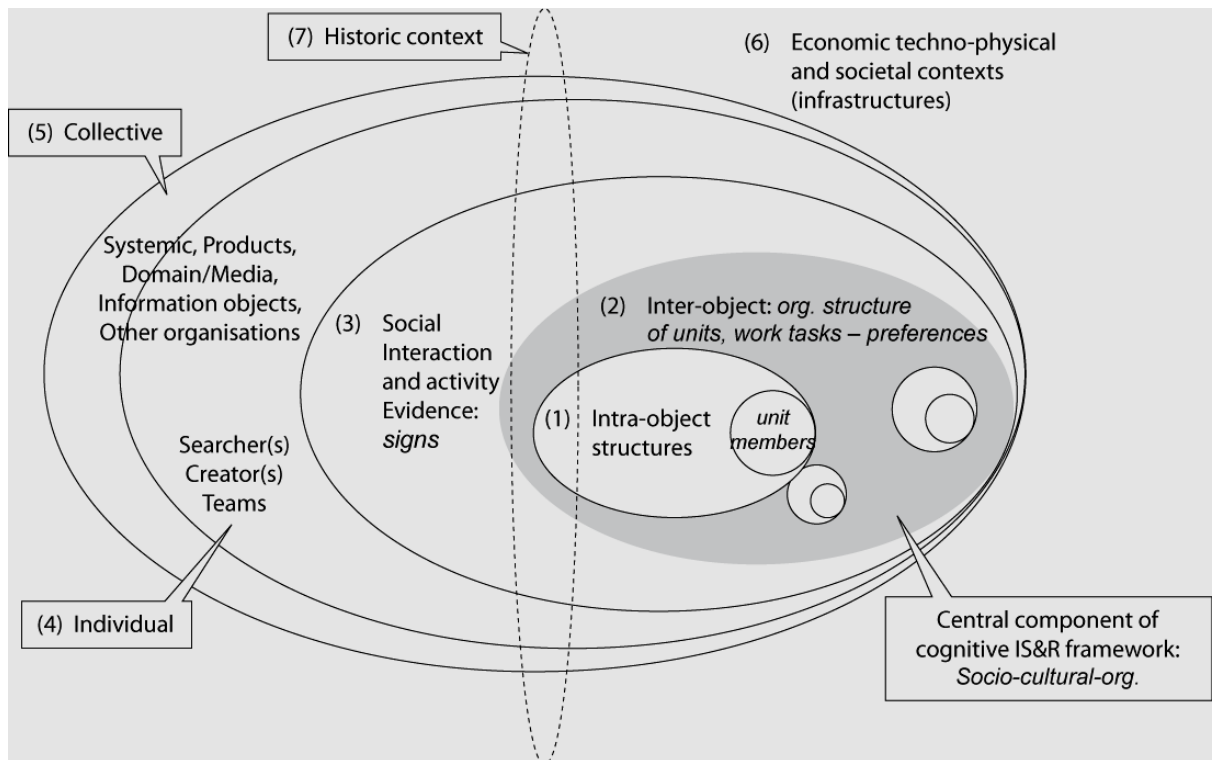


Figure 6: Nested model of context stratification for IIR – centred on
the local organisational, cultural and/or social environment

that natural work tasks develop, often owing to the preferences and goals of the organisation or sociocultural entity, such as an enterprise or a family. Explicit human relevance feedback (sign evidence) may be provided from the entity to local units or teams of searchers, authors, buyers or communicators interacting with that entity, throughout the interactive dimension 3 (Figure 6). This could also be called the *activity context* of the entity in question, in a broad sense of context. In this stratification one observes the products (knowledge or artefacts) made by the entity or by other organisations (context 5).

So, in order to be informed about an organisational entity (a firm, university department, laboratory, clan, family, etc.), it becomes important to capture evidence about:

- the internal network of units and their implicit preferences (and thus feedback to others), which might be different from explicitly stated goals or objectives/policies; and
- the (real or perceived) work task characteristics that may influence the communication and behaviour of single units, teams or individuals connected to the entity (context 4).

The latter individual elements and the organisational entity are themselves in the context of a *systemic environment* consisting of the local IT and technical options and platforms, information sources, retrieval and other algorithms, communication means and information access options (context 5 in Figure 6). This additional context, also shown on the left-hand side (Figure 2), should definitely be taken into account when analysing elements or units of the so-called "social context", for example in management or organisational studies.

A special case of studies are science and technology studies of context 5; for instance, in the form of scientometric analyses of research output and citation impact. In such analyses the knowledge products produced by the organisation in focus provide the evidence for the evaluation. As in the other context configurations above, the societal infrastructures are often difficult to incorporate directly in providing evidence in empirical studies, but should indeed be considered in analytic ones (context 6). As always, time plays a crucial role as the contextual dimension (context 7).

## 4. Concluding remarks

With reference to Ingwersen & Järvelin (2004; 2005), the *historic context* (dimension 7 in Figure 3) functions across all other contexts at a given point in time and serves to produce (evidence of) expectations concerned with the future steps in the IIR process and the surrounding components. However, present expectations relying on past experiences may indeed *not* always be satisfied by the conditions offered by the current context. For instance, the interface does not present documents in the expected form; the search algorithm seems incomprehensible; or the documents do not immediately satisfy the task requirements as well as they did in previous IS&R situations.

From the system's point of view, similar disappointments may occur with regard to searcher behaviour and provision of information – IIR in context does not only deal with the contexts of searchers or searchers *as* context. Information interaction in context also concerns the interaction between documents and the IT platform in the context of

domains, media and different kinds of work tasks (and non-job-related situations), as well as social constructs.

Furthermore, the local sociocultural and organisational setting is in itself in context of its communicative or interactive behaviour with people and products – these again in the context of technical and systemic (IT) possibilities and solutions. When investigating one of the six nested types of context in the stratified model, the nearby contexts should be involved in order to provide relevant and necessary *evidence* for understanding the phenomena – in particular with the time dimension in mind. Without adequate and robust evidence of phenomena of information interaction, and their comprehensive interpretation, IIR systems cannot handle such phenomena. Kelly (2006) recently initiated a large-scale study of evidence of context. The issue is not to apply as much context as possible, but to be selective and consistent, opting for realism at the same time as being in investigative control.

## REFERENCES

Dick, A. 2005. Power is information: South Africa's promotion of the Access to Information Act in context. In Crestani, F. & Ruthven, I. (Eds), *Context: Nature, impact and role.* Fifth International Conference on Conceptions of Library and Information Science (CoLIS 5). Berlin: Springer, 212-225.

Hyldegård, J. 2005. Collaborative information seeking behaviour: Exploring Kuhlthau's information search process model in a longitudinal group-based setting of students*. Information Processing and Management*, 42(1): 276-298.

Ingwersen, P. 1992. *Information retrieval interaction.* London: Taylor Graham.

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

Ingwersen, P. 2001. Cognitive information retrieval. *Annual Review of Information Science and Technology,* 34: 3-51.

Ingwersen, P. & Järvelin, K. 2004. Context in information interaction. In Bothma, T. & Kaniki, A. (Eds), *Progress in Library and Information Science in Southern Africa (ProLISSA): Proceedings of the Third Biennial DISSAnet Conference,* Pretoria. Pretoria: Infuse, 301-310.

Ingwersen, P. & Järvelin, K. 2005. *The turn: Integration of information seeking and retrieval in context.* Dordrecht: Springer.

Kelly, D. 2006. Measuring online information seeking context. Part 1: Background and method. *Journal of the American Society for Information Science and Technology*, 57(13): 1729-1739.

Nielsen, M.L. 2002. *The word association method: A gateway to work task-based retrieval.* PhD thesis. Åbo, Finland: Åbo Akademi University Press.

Rasmussen, J., Pejtersen, A.M. & Goodstein, L.P. 1994. *Cognitive systems engineering.* New York: Wiley.

Ruthven, I., Lalmas, M. & Van Rijsbergen, C.J. 2003. Incorporating user search behavior into relevance feedback. *Journal of the American Society for Information Science and Technology,* 54(6): 529-549.

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