Received 20 December 2002
Revised 17 February 2003
Accepted 17 February 2003

Documents and the communication of scientific and scholarly information

Revising and updating the UNISIST model

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Keywords *Model, Science, Communications, Documents, Internet*

Abstract *In 1971 UNISIST proposed a model for scientific and technical communication. This model has been widely cited and additional models have been added to the literature. There is a need to bring this model to the focus of information science (IS) research as well as to update and revise it. There are both empirical and theoretical reasons for this need. On the empirical side much has happened in the developments of electronic communication that needs to be considered. From a theoretical point of view the domain-analytic view has proposed that differences between different disciplines and domains should be emphasised. The original model only considered scientific and technical communication as a whole. There is a need both to compare with the humanities and social sciences and to regard internal differences in the sciences. There are also other reasons to reconsider and modify this model today. Offers not only a descriptive model, but also a theoretical perspective from which information systems may be understood and evaluated. In addition to this provides empirical exemplification and proposals for research initiatives.*

Introduction

In this article we would like to offer a revision and update of the UNISIST[1] model of scientific and technical communication published in 1971 (UNISIST, 1971). UNISIST is an intergovernmental programme for co-operation in the field of scientific and technological information. The UNISIST model was a product of four years of co-operation between the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Council of Scientific Unions (ICSU). Why revise and update such an old model, one may ask? There are two main reasons for doing this. First, the domain-analytic approach to library and information science (LIS), as advocated in recent years by Hjørland and Albrechtsen (1995) and Hjørland (1997, 2002a, b), stresses the importance of analysing and comparing differences between various knowledge domains and their communication structures with regard to, for

This article is partly based on a chapter in an unpublished textbook in Danish by Brier *et al.* (1997).

Journal of Documentation
Vol. 59 No. 3, 2003
pp. 278-320

0022-0418
DOI 10.1108/00220410310472509

instance, information retrieval and knowledge organisation. The UNISIST model holds the potentials, we argue, for outlining and understanding such structures, not only in science and technology – as originally envisaged, but also in other domains such as the social sciences and humanities. More recent models from the literature do not, in our opinion, show similar qualities. Second, due to developments in information technology, the model is inadequate today. Therefore, a revision and update that takes these developments into account seems in its place in order for the model to serve as a framework for further analysis and research.

Thus, for LIS, the UNISIST model offers an important socio-technical perspective on the activities of scholarly communication. It draws attention to information communication between knowledge producer and knowledge user, as a system consisting of diverse organisational and documentary units each contributing to the division of labour in scholarly communication. In so doing the model allows us to examine communication within specific domains or discourse communities and to compare differences between them. A mapping of these agents, their information services and document production regarding the provision of "the best textual means to an end" (Wilson, 1968, p. 21) should be an essential task of LIS research.

We will not go into detail with specific disciplines or domains in this article. The objective is to provide a general model capable of constituting a framework for specialised studies of communication structures in concrete domains. We suggest the differences between disciplines, or domains, as a new feature that hopefully can serve as motivation for further studies of specific disciplines or domains. The article and its Appendix offer an agenda for concrete analyses.

The article is structured into this introduction, three main sections and a conclusion. The next (second) section outlines and comments on the original UNISIST model and its many elements. The third section suggests improvements and extension of the model in light of the Internet; insofar as this has had an impact on scientific and scholarly communication. The fourth section offers some considerations regarding theoretical revisions with particular emphasis on disciplinary differences and provides examples of how these can be detected and studied.

The UNISIST model and its basic concepts

The UNISIST model is but one of many communication models. For LIS, however, it offers an important sociologically-oriented perspective on the activities of scholarly communication. It seeks to draw attention to information communication between knowledge producer and knowledge user, as a system consisting of diverse organisational and documentary units each contributing to the division of labour in scholarly communication. In so doing the model allows us to examine communication within specific domains or discourse

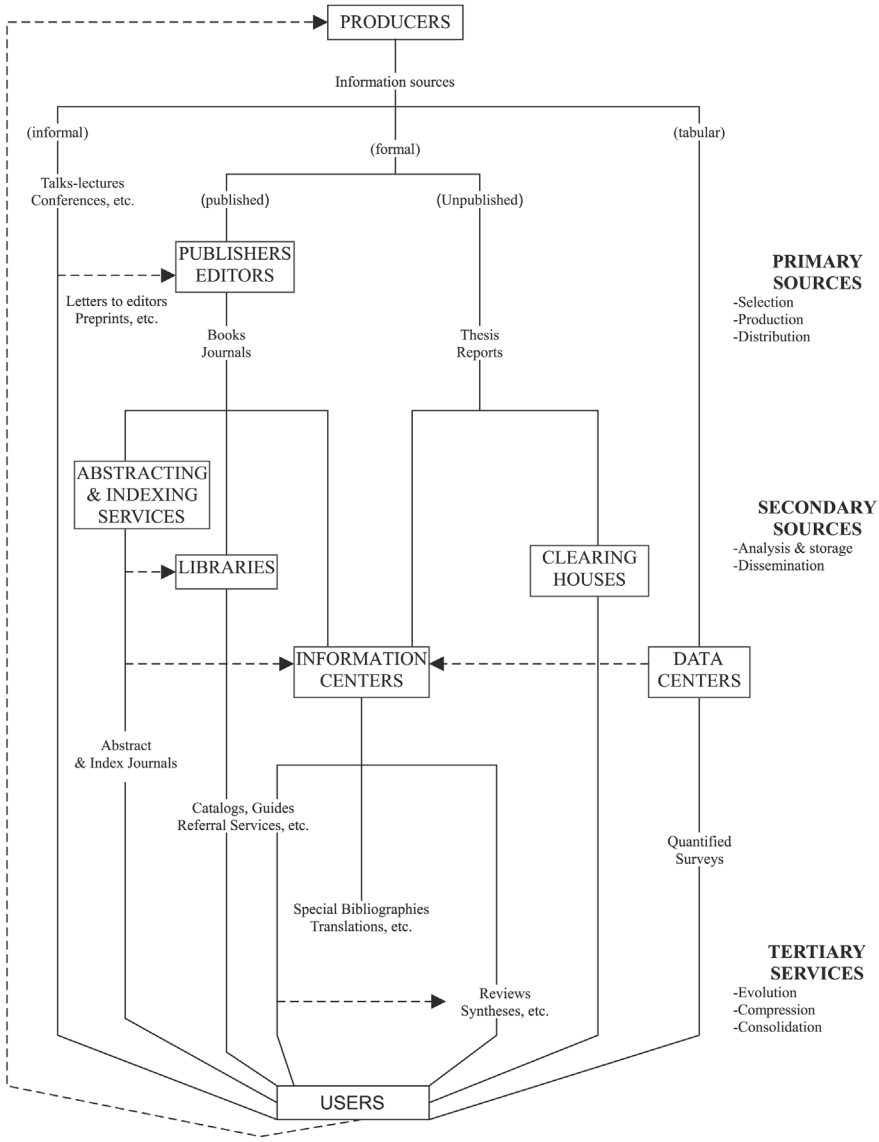
communities and to compare differences between them. A mapping of these agents, their information services, and document production should be an essential task of LIS research[2].

Figure 1 is a reproduction of the original UNISIST model (UNISIST, 1971, p. 26) by permission of UNESCO. This model was proposed as a generalised model of the information structures within science and technology (S&T) and of the organisation of communication therein. In order to discuss the model further in more detail in terms of its need for revision due to, for instance, technological innovations and diversity of various knowledge domains, and before discussing the updates of the model, a short description of the original model will be given. The outline below will stick to the description of the model made in the UNISIST (1971, pp. 25-33) report by defining the concepts in it. We also, however, suggest some new concepts. We also compare the concepts in the UNISIST model with other meanings of the same concepts. This is, for example, the case with the concept of information centres.

The point of departure in the model is the knowledge producers. They make up a multiform population organised in different groups or discourse communities implying that they have different patterns of information gathering behaviour. The group of producers has three main categories of information distribution channels available for communicating research: it can be done through informal and formal communication channels, or through tabular channels.

Informal communication takes place when the producer and the users know each other and exchange information via informal communication channels. These informal communication channels might consist of personal correspondence (i.e. letters), manuscripts and preprints, private exchange of bibliographical references etc., or might occur semiformal in connection with professional conferences, meetings, or lectures. That way the informal communication channels consist of two different genres of informal communication: a written part and oral part.

As for formal ways for communicating research two means are depicted in the UNISIST figure: the published documents and unpublished documents. The published documents (books and journals) go from the knowledge producer through publishers or editors from which the published documents, perhaps through abstracting and indexing services and libraries, and information centres reach the users. Being a published document means that it is available in public. This concept of publicity implies that documents have to be produced in several copies and be accessible to public or a representative part of this. It is not sufficient that documents are multiplied. Lecture notes distributed in 50 copies to students are not publications. Unique records publicly available in, for example, state archives do not constitute publications either. In this way bibliographic control with documents contributes to ensuring the visibility and publicity of documents. Moreover, the existence of



Note: Reproduced by permission of UNESCO

Source: UNISIST (1971, p. 26)

Figure 1.
The flow of scientific and technical information

publishers as scholarly institutions that are relatively independent of producers and their institutions (mostly research institutions) seems to be a condition for the concept of publications. Nonetheless, being a published document implies an increased amount of visibility compared with unpublished documents.

Unpublished documents consist of theses, supplementary material to printed work (e.g. numerical tables, films, detailed accounts of experiences, records, etc.), research and technical reports distributed in limited copies by, for example, government agencies (UNISIST, 1971, p. 29). The unpublished documents may reach the users through clearinghouses and information centres. That way unpublished documents are not subjugated the same selection, production and distribution mechanisms as published documents that go through the selection production, and distribution mechanisms of publishers and editors. The notion of grey literature is somewhere in between published and unpublished documents. A private letter is unpublished, while a report registered by a clearinghouse is semi-published or grey literature. PhD-dissertations, published on demand at University Microfilm International (UMI), indexed in Dissertation Abstracts are another example of semi-publications.

The third category for communicating research can be done through tabular channels. This consists of scientific and technical data. By this is meant data "... presented in a tabular form as opposed to the linear flow of spoken or written text in the preceding groups ..." (UNISIST, 1971, p. 29). The UNISIST report acknowledges that much tabular data are present in printed books and journals and unpublished documents. Yet, according to the UNISIST report there are several reasons for operating with tabular data as an information source on its own. First of all, the large amount of quantitative surveys being carried out has resulted in an accumulation of quantitative data. Second, printed literature is not considered by the UNISIST report to be the most appropriate publication channel for communicating tabular information due to the progress of mechanized data banks "... that offer in this case better-suited retrieval and computing facilities." (UNISIST, 1971, p. 29).

So far the primary sources of scientific and technical information have been described in terms of their selection, production and distribution functions. Primary literature is the point of departure in the production of scientific and scholarly knowledge and, thus, also for the communicative division of labour of the literatures involved. The task for primary literature is to produce and present new knowledge. The "proof" for this new knowledge happens through documentation of knowledge claims through the production and publication of a document. Thus, primary literature constitutes a subject field as a field of knowledge, and contains, ideally, the basic results and insights of a subject field.

In the UNISIST model we can further observe two levels of information sources services between the knowledge producers and users: secondary

information sources and tertiary information services. The secondary information services register and describe primary documents for the purpose of retrieval and documentation. Secondary literature such as subject bibliographies, citation indexes, library catalogues and databases analyses, describes and registers primary literature (mainly but not exclusively) in these bibliographical instruments. The central working processes of the secondary sources are analysis, storage and dissemination. In the model abstracting and indexing services, libraries, information centres, clearinghouses and data centres are considered secondary information services, but each with particular functions to perform. Tertiary literature consolidates, collects and synthesises the primary literature.

Abstracting and indexing services

Abstracting and indexing are major topics in LIS. In this place, we shall only put a few comments on the UNISIST model. The reader may consult standard works on this field, e.g. Lancaster (1998) and Manzer (1977). The UNISIST model distinguishes between two kinds of abstracting and indexing services. The first consists of those printed secondary journals prepared and distributed by scientific associations and who operate on a profit basis (UNISIST, 1971, p. 30)[3]. An example of this kind is Chemical Abstracts or the citation indexes produced by the Institute for Scientific Information (ISI); that is the content of these does not represent collection of a physical location such as a library. The other "consists of catalogs and index files compiled by the staff of libraries or information centres, as a mean of access to their own collections" (UNISIST, 1971, p. 30). As for libraries, guides and referral services also belong to this kind of secondary service. Referral services is "... the indication of sources (persons, institutions, publications, etc.) from which scientific information may be obtained on a given subject; mechanisms for switching users to such sources" (UNISIST, 1971, p. 148). Accordingly, it is only the physical location and the collection attached to it, which differentiates this second kind of abstracting and indexing service (i.e. libraries and information centres) from the first one.

The concept of information centre

As for the concept of an information centre, the UNISIST report states further that "... the information centre then combines some of the functions of secondary journals and specialized libraries, to which are added specific duties such as the selective dissemination of information, or the preparation of state-of-art monographs, trend reports, reviews, etc. for the benefit of a specialized field or well-defined and more restricted user groups" (UNISIST, 1971, p. 30). This explains partly why the UNISIST model apparently operates with tertiary services in connection with information centres: "The role of such [information] centres is sometimes spoken of as that of 'repackaging' the information provided by abstracting and indexing services, according to the requirements

of specific users; they operate then as 'tertiary' services, with a synthesis function added to those of indexing and classification: reorganization, quality control, compression, synthesis, evaluation etc." (UNISIST, 1971, p. 30). Typical examples of tertiary documents in this regard are reviews and syntheses.

Thus, according to the UNISIST model an information centre takes on tasks, both having secondary and tertiary functions, such as for instance the preparation of special bibliographies (e.g. subject bibliographies), translations and reviews or syntheses (e.g. state-of-the-art report). They do so by getting input from abstracting and indexing services and data centres, which the arrows in the figure seem to suggest. Among other things, this implies that the concept of an information centre, as conceived of by the UNISIST model, is broader than libraries. By ascribing to information centres functions both covering secondary and tertiary functions, information centres actually differ from libraries. It may be claimed that libraries are a kind of information centre, where as the latter is not a kind of library. Libraries do not produce reviews or syntheses, or other kinds of tertiary documents. Moreover, information centres are normally not in possession of a physical collection of documents and are not primarily concerned with giving access to these collections, as are libraries.

At the time of writing of the UNISIST (1971) model, information centres were often conceived of as centres that delivered bibliographic references or information from documents ("information", but not documents; see also Hjørland, 2000). It has often been seen as an ideal to provide pure information. Documents have been seen as obsolete containers of information. However, as Spang-Hanssen (2001) wrote:

> Information about some physical property of a material is actually incomplete without information about the precision of the data and about the conditions under which these data were obtained. Moreover, various investigations of a property have often led to different results that cannot be compared and evaluated apart from information about their background. An empirical fact always has a history and a perhaps not too certain future. This history and future can be known only through information from particular documents, i.e. by document retrieval.
>
> The so-called fact retrieval centres seem to me to be just information centres that keep their information sources – i.e. their documents – exclusively to themselves.

Centres for the delivery of bibliographical records (usually for a fee) from electronic databases rapidly developed from about 1965 until 1990 usually as part of libraries, particularly in the scientific and technological fields. Such departments were important, for example, in the Danish Technological Library and in the main medical library in Copenhagen (and correspondingly, for example, in Stockholm as well as in other countries). They were usually termed Documentation Departments. With the introduction of CD-ROM databases and "end-user"-oriented search interfaces around 1990 these departments have by and large disappeared or have been downsized.

Information centres, as conceived of by UNISIST (1971), seem also to differ from documentation centres, a type of centre not mentioned in the model either.

For example, the European Documentation Centres (EDC) (http://www.uni-mannheim.de/users/ddz/edz/eedz.html) who "have the task of cataloguing the interesting EU publications and to make them accessible to university sectors as well as to the general public" (quoted from the homepage: http://www.uni-annheim.de/users/ddz/edz/eu_info/adr/eedz.html), do not seem to have the objective of producing syntheses or reviews. They merely have the more traditional library task of cataloguing documents, with attention exclusively paid to EU publications.

Furthermore, there are for instance international music information centres organised in the International Association of Music Information Centres (IAMIC (http://www.iamic.net/)). In Denmark there is a music information centre (MIC (www.mic.dk)). MIC's tasks are (quoted from www.mic.dk) to:

- Disseminate the knowledge – nationally and internationally – of Danish music and music life, within all genres.
- Provide existing information, registration and documentation of Danish music and music life.
- Coordinate the initiatives abroad to ensure the best possible use of the public financed subsidy.

Thus, it may be claimed that the MIC is performing a function similar to that of a library. But unlike a library it has a broader agenda in that it also co-ordinates music activities outside Denmark in order to promote Danish music. MICs have only small collections of books (e.g. reference collections) and concentrate on new national music. They perform important documentary functions (collecting, recording and documenting music, which is why they can be seen as documentation centres) as well as disseminative functions, not least in countries abroad. They perform, therefore, functions that are not traditionally library functions (and which may be difficult to carry out given the socio-political structure of the library system). That is, viewed in this way the notion of a MIC also differs from the rather unspecified notion of information centre in the UNISIST model.

One library, however, the Danish Kvinfo, Danish Centre for Information on Women and Gender, may be seen as an example of a broader concept of "library". This library in fact carries out important functions related to that of information centres. For example, it edits "Women on line" a database of women experts containing easy-to-access biographical information on professionally qualified women in Denmark (http://www.kvinfo.dk/kvinfo-english.htm).

Also the German concept of *Zentralstelle für Information und Documentation* deserves to be mentioned in this context. These centres exist in a broad spectrum of disciplines, such as the *Zentralstelle für Psychologische Information und Documentation* in Trier, Germany. They systematically document German scholarly literature within their fields, build bibliographical

databases (with abstracts and indexing in both German and English compatible with American databases in the same field) and construct thesauri (in German and English, compatible with American thesauri in the same field). These centres also perform research activities such as bibliometrical investigations and science studies within their fields.

In the LIS literature the concept of information centre has also been under scrutiny. The *Journal of the American Society for Information Science*, for instance, devoted in 1991 a special issue to the concept. In this issue Straub and Beath (1991), among others, described the concept of an integrated information centre. They seem to conceive of the concept as a unit within an organisational department that co-ordinates the information activities of the various units in the department. By the use of computer technology, an integrated information centre would be responsible for gathering information from external as well as internal sources and synthesise and present it in a manner suitable for those going to use it in the particular unit(s). Conceived of in this way Straub and Beath's (1991) description of an integrated information centre seem in some way to resemble the UNISIST conception of an information centre. In both conceptions emphasis is put on the aspect of synthesising information from a variety of sources. However, there are also differences. In Straub and Beath's description the integrated information centre is part of the division of labour of an organisation. UNISIST seem to consider an information centre as an organisation in its own terms. Another difference is that according to Straub and Beath (1991) is an information centre also responsible for the workings of the hardware and software within an organisation.

To recapitulate, the concept of information centre is a concept filled with ambiguity and it is not clarified in relation to similar concepts such as libraries or documentation centres or knowledge centres[4]. The UNISIST model only operates with but one outline of the concept. In the following we intend to use information centre as an umbrella term for libraries, documentation centres and other similar activities concerning the collecting, dissemination, storing, retrieval and organisation of documents (or knowledge).

Clearinghouses

The analysis, storage and dissemination of unpublished documents are a task undertaken by clearinghouses. Clearinghouses are defined by UNISIST as "... institutions entrusted with the procurement and dissemination of special categories of documents, such as technical reports, dissertation theses, thesauri, etc." (UNISIST, 1971, p. 147). The modes of analysis, storage and dissemination are, according to the UNISIST report, the same as those of libraries or information centres. However, what differentiates clearinghouses from libraries or information centres is the attention exclusively paid to unpublished documents. With regard to unpublished documents, the UNISIST report seems to differ in its conception of the activity of a

clearinghouse when compared with clearinghouses such as the Clearinghouse of Federal Scientific and Technical Information (CFSTI)[5] or the Educational Resources Information Center (ERIC), an organisation consisting of several clearinghouses covering all aspects of education and pedagogy. These kinds of clearinghouses all collect documents or information from a particular subject field or of a certain type and distribute documents or information about what is collected (see e.g. Marron, 1971; Sauter, 1971).

Data centres

The UNISIST model conceives of data centres as being different from the above-mentioned secondary services, because "... they [data centres] deal exclusively with the raw material of science, parallel or even prior to publication.. ..." (UNISIST, 1971, p. 30), and because the functions (cataloguing, abstracting, indexing, synthesising, etc.) of the other kinds of secondary services "... are normally defined with respect to written documents" (UNISIST, 1971, p. 31). That is, the UNISIST model conceives of data centres as being concerned with "raw" data and non-written documents such as quantified surveys. Further the model does not consider data centres as instruments for retrieval: "... it is only natural that data processing centres should generally be considered as instruments for research rather than retrieval, and associated with methods that are closer to those of mathematical problem-solving than to the more straightforward search procedures in documentation" (UNISIST, 1971, p. 31). While the functions of the other kinds of secondary information services are defined with respect to retrieval, this apparently does not apply to data centres.

We intend, however, to consider data centres as part of the other units in the model as data are being published through formal communication channels such as publishers, implying that we will exclude data centres as an independent form of information service and information source. This decision not to regard data centres as a specific communication channel is also motivated by the facts that other kinds of messages such as computer programs, pictures and sounds are not represented by separate channels.

Special bibliographies, translations, etc.

As seen on the UNISIST model, organisations for information and documentation may produce special bibliographies, whether current or closed. For example, the American Psychological Association publishes the current bibliography *Psychoanalytic Abstracts* and has published the closed bibliography *Peace: Abstracts of the Psychological and Behavioral Literature, 1967-1990* (Blumberg and French, 1991). Often such special bibliographies make use of subject specialists, while such special bibliographies may help identify information sources that subsequently are included in more general bibliographies such as the PsycINFO database.

Translation services may be commercial or government centres, it may be special translation journals (e.g. "cover to cover" translation of Russian scientific journals to English) or it might be bibliographies covering translations (such as *Index Translationum. Répertoire International des Traductions/International Bibliography of Translations*, published by UNESCO). Today research in both manual and machine translation and cross-lingual retrieval are important areas in fields like artificial intelligence, information science, computational linguistics, etc.

Review, syntheses, etc.

Reviews in this place should not be confused with book reviews. They are syntheses of the primary literature, e.g. in the form of handbooks, review articles, scientific and professional encyclopaedias, and the like. (Whereas works like general encyclopaedias that are not primarily written for subject specialists are not part of the scientific literature described in the original UNISIST model.) One important kind of tertiary literature is the series titled Annual reviews of X, e.g. the *Annual Review of Information Science and Technology*. One publisher, Annual Reviews Inc. (http://www.annualreviews.org/), has specialized in publishing such yearbooks, many of which have high impact factors in their respective fields[6]. In information science Fix *et al.* (1964), Garfield (1982, 1987a, b), Light and Pillemer (1984) and Woodward (1977) are examples of research on scientific review literature.

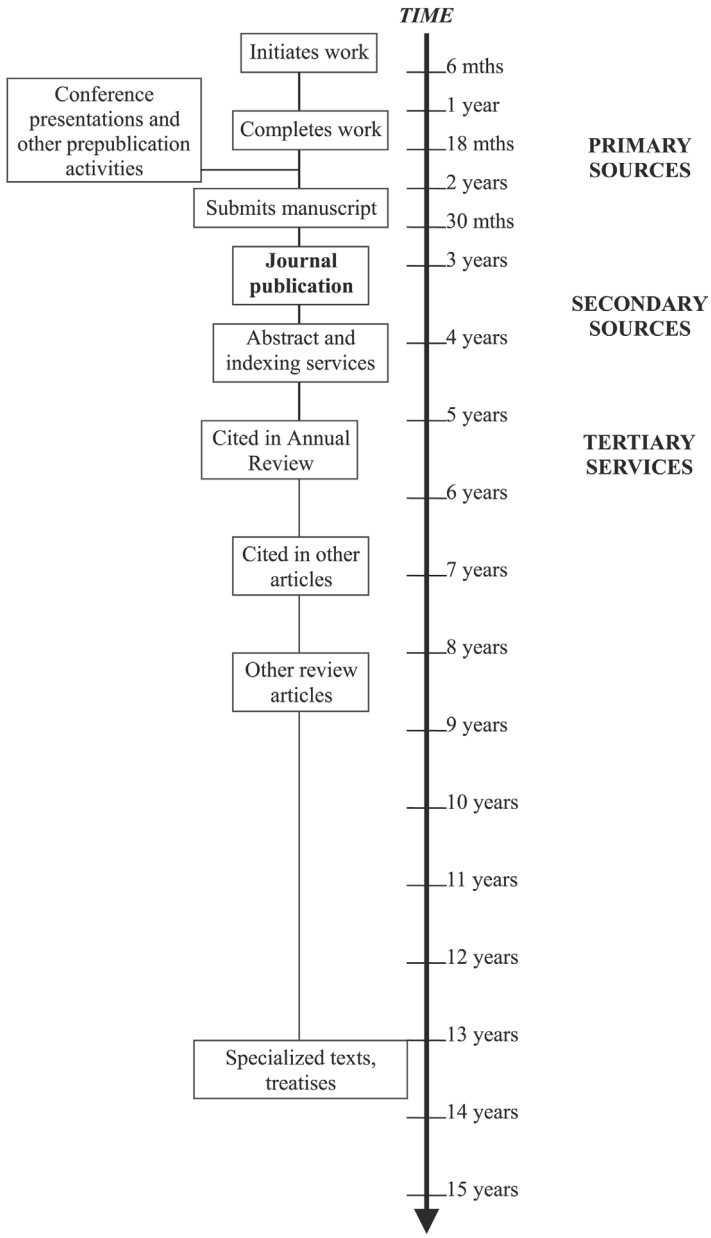
Users

The final unit in the model is the users. The users of scientific and technical information are in most cases also identical to the producers, or the users may also be practitioners such as physicians. Among other things, this means that the distance between users and producers is short. However, the UNISIST report warns against placing too much reliance in the dotted line from users to producers (UNISIST, 1971, p. 31). This is so because users have different needs when acting as users and as producers, and because these needs then are stated in different contexts. In this way the model is an idealisation at this point.

The time dimension in communication

An aspect the UNISIST model leaves out in its outline of scientific communication is the time dimension present in knowledge production and use. Garvey and Griffith (1972) emphasised in their study the relevance of taking this dimension into account when illustrating the activity of knowledge production.

A somewhat simplified and modified version of their model is shown in Figure 2. According to this model the average time from the initiation of a research project until formal publication in a scientific journal is three years. One year later a bibliographical record in the abstract databases can be found. Gradually the research findings are visible in review articles, cited in other



Source: Modification of a model in Garvey and Griffith (1972, p. 127)

Figure 2.
The time perspective in knowledge production and use

publications, mentioned in specialised texts etc. Garvey and Griffith (1972) do not apply the terminology of primary, secondary and tertiary sources, but they add a time perspective useful for incorporating into the UNISIST model. Their major findings were related to the role of informal communication in science, which at that time was a "hot topic" in information science. We shall not in this paper discuss their research in any detail. It is important to observe, however, that, for example, the bibliographical databases typically do their job much faster today compared with 1972. In many cases bibliographical records can now be available one week after journal publication. We also want to stress that we do not think that one should only look at the average time it takes for a research finding to be visible in one or another kind of publication or information service. There may be systematic variations in such patterns that are important to study. For example, patterns related to geographical structures and to paradigmatic issues. An information system may be very much dominated by US in one period, why foreign papers in this period may have a more slowly dissemination. The rate of citation in other papers is also mainly determined by epistemological factors (as shown by Hjørland (2002a, b)). Further empirical studies of the time perspective in the dissemination of scholarly knowledge are much needed as are theoretical studies that may help explaining such patterns (see also Kling *et al.* (2003) and Rogers (1995)).

Conclusion

We have now described the various means and modes of the communication of scientific and technical information as depicted in the UNISIST model. The model shows that the communication of scientific and technical information takes place through many diverse organisational units (publishers, editors, abstracting and indexing services, libraries, information centres, clearinghouses and data centres) and documentary units (books, journals, theses, reports, abstract and index journals, catalogues, special bibliographies, reviews, quantified surveys).

As for the model we would like to add some documentary units we feel are not clearly emphasised in the original UNISIST model[7]. The model notably leaves out book reviews as part of the published, formal mode of communication. We therefore suggest that book reviews are given a place in this communication structure given the importance of these in the dissemination and evaluation of scholarly monographs (see, e.g. Lindholm-Romantschuk, 1998; Hyland, 2000, pp. 41-62). Furthermore, we feel that important secondary literature such as dictionaries and thesauri need to be emphasised in the model and we therefore suggest bringing them in. As for tertiary literature, we would also like to add handbooks and encyclopaedias. Neither do they seem to be taken into account by the model. A comprehensive listing of our extensions of the model is given in the Appendix. Incorporating these documentary units broadens and strengthens the model with regard to its

capability of serving as a theoretical model for analysing the differences in communication structures among a variety of scholarly and scientific domains[8].

Moreover, as for the documentary units, the model apparently does not seem to take into account how and in what ways primary, secondary, and tertiary literatures shape and respond to each other as part of the communicative division of labour in science. This is an important aspect in terms of how to examine in what ways the various types of labour the literatures involved in scientific and scholarly communication carry out work that may or may not optimise the communication of scientific and scholarly information (Andersen, 2002). Furthermore, the model leaves the impression that scientific communication and scientific knowledge production takes place in isolation. It only describes what Fleck (1979) has called the esoteric circle of science, the circle of specialised and initiated experts. In addition to this, Fleck (1979) argued that the structure of the thought collective[9] of science consists of both an esoteric and an exoteric circle, the latter consisting of "educated amateurs" (Fleck, 1979, p. 111). Since what Fleck (1979, p. 113) called a "*Weltanschauung*" (i.e. world view) provided "... the background that determines the general traits of the thought style of an expert"[10], exoteric knowledge "... shapes specific public opinion as well as the *Weltanschauung* and in this form reacts in turn upon the expert" (Fleck, 1979, p. 113). In this respect Fleck seemed to recognise what the UNISIST model does not seem to consider, namely, that there is dialectic between the social organisation of science and the broader social organisation of society because the latter may also serve as an input to specialised knowledge production.

We will consider the model of scientific and scholarly communication as an expression of rather stabilised and typified forms of practice. That is, on the one hand we do not intend to examine the model as an abstraction with no connection to scholarly communicative activity and practice. On the other hand we will not examine the model in such particularistic terms that it cannot be applicable to comparative analysis. By focusing on, for instance, domain-specific characteristics or national characteristics, we are able to illuminate how domain-specific characteristics or national characteristics as stabilised and typified forms of practice shape the very communication system they are part of.

Thus, due to the influence from, for instance, various epistemologies, ideologies, technological innovations, or domain-specific characteristics each level or unit in the model does not portray the interactions going on between these levels or units or their potential significance for particular scientific or scholarly domains. This is what we intend to examine a little further in the section entitled "Some theoretical revision of the UNSIST model"

The Internet – a technological updating of the UNISIST model

The growing use and impact of Internet-based communication channels[11] has changed the flow of scientific communication vitally since the creation of the UNISIST model[12]. A technological updating of the model is therefore an absolute imperative. The special perspective of the UNISIST model implies that other proposed models of electronic documents and scholarly communication put forward by, for example, Kling and Callahan (2003), Kling *et al.* (2003) or Hurd (2000) cannot be directly utilised for this task. Furthermore we find that the UNISIST model is more rewarding and motivating for further empirical research.

A description of the diverse documentary and organisational units on the Internet often emerge from a classification of hardware or software technicalities, rather than classification by traditional communication parameters, as for example the division into formal and informal communication used in the UNISIST model. As early as 1978 Lancaster suggested that "the distinction between formal and informal communication will be much less clear in an all-electronic environment" (Lancaster, 1978, pp. 113-14; see also Hurd, 1996; Meadows, 1998; Russel, 2001). Although this is true for many of the new hybrid forms[13] most people would agree that an intuitive distinction between formal and informal is possible in everyday Internet-based communication. The distinction made here is based on how the channels are actually used instead of their ability to carry either informal or formal communication.

Informal communication

Consistent with contemporary use of the informal communication channels the most significant informal documentary units on the Internet are:

- E-mail.
- List servers, which is a discussion group or interest group that distribute messages via mailing lists. Electronic conferences or newsletters are both usually listserv mediated.
- Usenet news, which is a collective term for thousands of newsgroups or discussion groups. Usenet news is managed centrally without the use of email in contrary to list servers. The messages or articles are most often cumulated and archived at least for a while. In most cases this group includes bulletin boards, which is now rarely used on its own but rather as a feature among others in newsgroups. Thus Lancaster (1978, p. 130) defined bulletin boards as a "public space to permit messages to be entered and made accessible without restriction to all users of the system".
- Electronic meeting or Webcam conferencing.

In the 1980s several authors (e.g., Piternick, 1989, p. 265) expressed a tendency for the use of the Internet primarily to facilitate informal communication as for instance e-mail. According to an American survey made by Walsh *et al.* (1999) the average PhD respondent began using e-mail in 1990, although with notable differences existing between domains[14]. Without doubt e-mail is the most used and the first generally adopted Internet application. This may explain why list servers seem both wider and more often used than Usenet news[15] as list servers are e-mail-based distribution channels. The ARL Directory of electronic journals, newsletters and academic discussion lists[16] from 1997 carried information on just over 3,800 different list servers and Usenet news newsgroups, while the 2000 edition contains over 4,600 entries. This suggests the rate of which the use of these Internet-based communication channels are growing.

If not otherwise known, and therefore directly accessed, each of these informal communication channels on the Internet may be intentionally located by the user through either various search engines; also included meta search tools such as Metacrawler that allows you to access several search engines from one place, or through diverse types of virtual libraries; the latter defined by Ackermann and Hartman (1998, p. 21) as directories or subject catalogues consisting of selected Web resources[17]. However, informal communication channels often become known to the users in the course of fewer goals-oriented manners, such as serendipity, general browsing or inter-personal contact.

Generally speaking, the Internet mediates a less selective spread of informal communication than the preceding non-electronic communication channels. Thus an invite is not needed to participate in informal communication on the Internet. Information once available only through the professional grapevine is now found on personal or institutional Web pages (Russel, 2001, p. 274). This is one of the reasons why the Internet is believed to have a positive effect on the development of invisible colleges in the otherwise stratified scientific community. Harnad (1991) has argued that when (informal) manuscripts and feedback are exchanged through the network, scholarship can progress at a speed more similar to that of natural thought and speech. Because of the ease of using the informal Internet-based communication channels the path from the producer to the user and vice versa, is more freely and quickly accessed and less troublesome engaged than for example postal mail (see Figure 3).

Formal communication

The increasing number of computer literate scholars up through the 1990s, among other things, brought about the transition of the Internet from a predominantly informal communication channel to a significant formal communication channel.

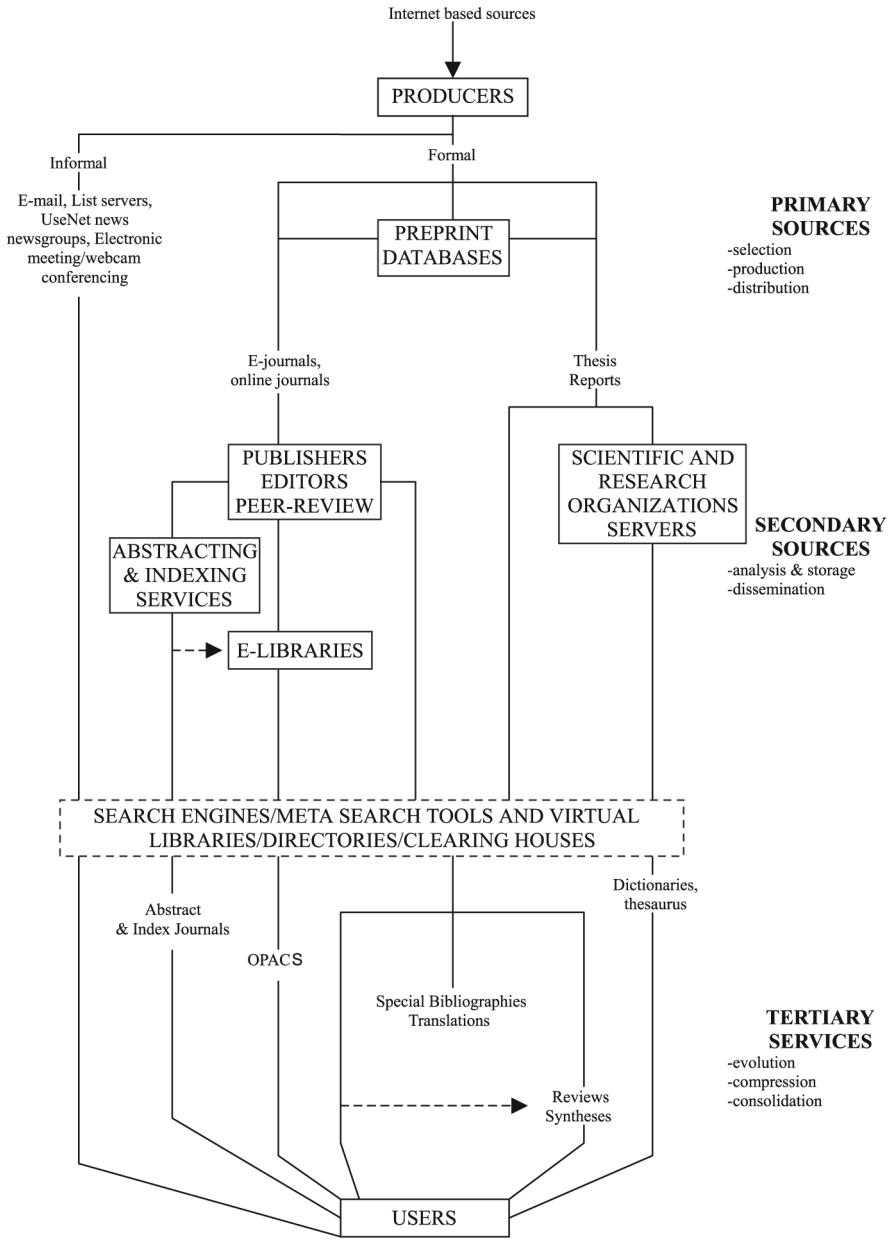


Figure 3.
The communication of Internet-based scholarly information

The most significant formal documentary units on the Internet are:

- *E-journals and online journals.* The true concept of the "electronic journal" or simply e-journal, as opposed to the "online journal", requires that the material be produced and stored only in electronic form (Piternick, 1989, p. 263). Online journals on the other hand are electronic spin-offs from paper journals.
- *Preprints.* Although some redaction has often occurred preprints are documents distributed before the actual publication and perhaps before the peer-reviewing process is completed. Preprints are often considered as part of grey literature, but in recent years the emergence of preprint databases on the Internet has offered the means to gain access to this document type. However, not all knowledge domains have or use preprint databases, therefore depending on which knowledge domain is considered preprints may or may not be considered grey.
- *Grey or unpublished literature.* These are items such as thesis, reports etc. mostly found on scientific and research organisational servers.

Most e-journals devoted to research in the 1980s and the first half of the 1990s were created by enthusiasts, usually in the academic world in North America (Meadows, 1998 p. 76). Real, operational e-journals are essentially phenomena of the late 1990s. The first peer-reviewed electronic, full-text e-journal including graphics was *Online Journal of Clinical Trials*, which only began publication in 1992 (Keyhani, 1993).

The status of e-journals is still not fully established. Meadows stated in 1998 that some universities have yet to accept that electronic publications can be equivalent to print on paper for such purposes as deciding on promotion. Furthermore articles in e-journals are not subsequently accepted for publication in printed journals nor are they necessarily regarded an equal acceptable source to cite (Meadows, 1998, pp. 202). In a longitudinal citation analysis performed by Zhang from 1991-1998 (Zhang, 2001 p. 628) a notable increase in authors who cite e-sources were found. Although still less than print sources this suggests a wider use and recognition of e-sources in the scholarly community (Zhang, 2001, p. 644).

Research completed in 1996 showed that some e-journals actually have a high impact factor. However, as Harter (1998, p. 515) points out, the total number of articles that are published is poor: "Indeed, e-journals cannot have a major impact on the advancement of knowledge until they publish many more articles annually than they do [in 1996], while maintaining the apparent high quality of their articles".

Hitchcock *et al.* (1996) identified 115 scholarly, peer-reviewed e-journals in the subject area of science and technology (Harter, 1998, p. 507). But already the following year approximately 30 per cent of the 3,400 entries in The *ARL*

Directory were identified as peer-reviewed. The current online version of the directory contains collectively over 4,800 titles, all of which are peer-reviewed.

The peer-review system is an important component in scholarly publication and is now a fairly well-described process. Weller (2000) indicates that the peer review process of e-journals is generally similar to the traditional process found in paper-based journals. However, new models of editorial peer review have been suggested, and some are being experimented with, that either alter or eliminate the traditional model of peer review. It is most important that any new model maintains the integrity of science and scholarly communication and yet implements the new emerging electronic environment and the need for decreasing turn-around time. As an example Weller (2000) mentions that in the electronic environment there is a need to re-examine the anonymity of reviewers[18].

The number of fee-based online journals has risen dramatically, confirming the notion that traditional academic publishers have now joined the ranks of electronic publishing (Mogge, 2000). How this commercialisation affects Internet-based scientific communication is still unknown. In 1998, most of the major publishing houses were offering some form of electronic product aimed at the academic marketplace (Peek and Pomerantz, 1998, p. 321), realising that they need to rethink the value they add to the scholarly communication chain (Lally, 2001, p. 84). Exactly what constitutes value-added publishing is highly domain specific (see also Russel (2001, p. 274)). Lally (2001, p. 83) stresses, for instance, the importance of retro-digitisation projects[19] in the humanities. In other domains it might be more important to improve the display of graphics, colour or even motion pictures.

Regarding the development of preprint databases the Internet as a new media played a vital role. Due to the scholarly community's discontent with publishing delays and distribution problems with paper journals, Paul Ginsparg created Los Alamos ePrint archive[20] in 1991. Smith (1999, p. 5) who sees journals merely as an overlay on preprint databases describes the powerful position of ePrint archives: "The tension concerning responsibility for public distribution and communication of new work has been resolved in favour of the electronic preprint databases. Traditional journals still have some role in communication, providing archival material and inter-linking, but they no longer form the primary communication medium at either the formal or the public levels". As follows the Internet has changed the perception and use of this document type at least in some science domains where rapid dissemination is required. However, further research is needed to identify and explain differences between domains on this matter.

If the development continues in line with Smith's ideas for the future it could be argued that journals (electronic or paper-based) should be positioned as a secondary source instead of its present location among the primary sources. Smith (1999) argues that the main purpose of the typical journal will be of

storage and as a sign of formal confirmation, and the preprints will adopt the traditional journals communicative role. Whether or not this will come about depends on domain specific conditions. The traditional position of journals is therefore maintained in the domain general model of Internet-based scientific and technical information (see Figure 3).

Grey literature

The Fourth International Conference on Grey Literature defined grey literature as follows: "That which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers" (Grey Literature Network Service, 1999). Grey literature on the Internet is, if possible to locate, very easily accessed compared with non-Internet-based alternatives. In research made by Luzi (1997) completed in 1995, it was found that scientific and research organisational servers convey information that may be classified as grey. Consistent with Luzi's research, Goodrum *et al.* (2001, p. 662) state that "authors, institutions, and archives are making formal research publicly available on their Websites in PDF, Postscript, and other formats". The Internet has created an opportunity to make grey literature publicly available without the expenses of traditional publication.

Several organisations, associations and information systems such as the European Association for Grey Literature in Europe (EAGLE)[21], Information for Grey Literature in Europe (SIGLE)[22] and the British Library Document Supply Centre (DSC) are making special efforts to raise awareness of and provide access to grey literature such as reports, theses, translations, non-commercial conferences and official (government) material. Several bibliographies (often domain specific) devoted to grey literature can be found on the Internet. The problems concerning grey literature are therefore being addressed on international level but may still demand the searcher to be rather persistent.

Formal communication channels

If not otherwise known and therefore directly accessed, the formal documentary units (in particular journal articles) on the Internet may reach the user through diverse organizational units (see Figure 3), such as Web editions of:

- *Preprint databases.* In the literature these databases are not referred to as clearinghouses as found in the original UNISIST model. On the Internet the term clearinghouse seems to denote some kind of annotated directory or resource guide (see for example the Argus clearinghouse at http://www.clearinghouse.net/mission.html for further information). Preprint databases primarily flourish within the science domains such as Los Alamos ePrint, LANL preprint database and SPIRES.

- *Bibliographic or full-text databases.* Representing both commercial (First Search, DIALOG, STN, Lexis-Nexis) and non-commercial databases available on the Internet (OPACs also called electronic libraries or e-libraries).
- *Scientific and research organizations servers.*
- *Publisher Web sites.*
- *Virtual libraries as defined earlier.*
- *Search engine or meta search tools.*

As with the role played by preprints Smith (1999) also anticipates changes in the function of preprint databases. Preprint databases are expected to become responsible for public distribution and communication of new works. This means that the user needs to have great domain specific knowledge or expertise since the content of these databases may not necessarily have finalised the peer-review process. For this reason Smith presumes review papers to take on a more prominent role in providing guidance to the literature for those not familiar enough with the domain to deal with the raw (non reviewed) preprint literature. Consistent with Smith's view, the preprint databases are positioned in the midst of the primary sources in the flow of Internet-based scholarly information (Figure 3).

The majority of bibliographic or full-text databases are available both via telnet and the Internet (given a password), but many databases have yet to adapt and value-add their services to this media. Although Web of Science may be given as an example of how the link structure can be exploited in an end-user friendly database, there is still a long way to go before the full potentials of the link structure is utilised for value-added service. Commercial bibliographic and full-text databases mainly evolve around articles from peer-reviewed journals and to a lesser degree conference proceedings and books. Documentary units as thesis and reports are often neglected which means that these documentary units can only be found through use of special databases such as SIGLE or general search engines or through specific scientific and research organisations servers if not otherwise known. The terms electronic libraries (e-libraries), digital libraries and virtual libraries are often used rather inconsistent and several different definitions are seen in the literature (see for example Arms (2000)) and yet others are in use on the Internet (see for example http://www.jsu.edu/depart/library/ graphic/virtlibr.htm).

The preservation of paper-based scientific communication is a part of the secondary organisational units in the original UNISIST model (e.g. libraries copyright deposits). Regarding Internet-based scientific communication exclusively, the division of labour is still inconsistent and selective. While some countries (e.g. Denmark since 1998) do have a rather selective copyright deposits for static Web documents, several archival initiatives are seen on the Internet. The Internet archive (http://www.archive.org) is as an example of the

preservation of former versions of Web sites, but also more subject specific archives can be found.

In agreement with publishers wish to value add their services, their Web sites are increasingly providing access to publications in addition to more traditional information such as subscription prizes, contributor instructions and review policies. The specific searching and browsing facilities on these sites vary. Likewise both opportunities to view, print or request documents differ and whether or not such services require payment differ also. Traditionally the publishers' role was principally connected to selection, production and distribution of the primary sources. However, a movement towards the tasks of storage and dissemination can be found on the Internet. Some publishers are beginning to utilise cross-referencing or reference linking as a browsing option. CrossRef is a collaborative reference linking service that functions as a sort of digital switchboard. It holds no full-text content, but rather effects linkages through digital object identifiers (DOIs) that are tagged to article metadata supplied by the participating publishers. The end result is a linking system through which a researcher can click on a reference in a journal and access the cited article[23].

These facilities, however, are only available to the users who subscribe to the various publications. A researcher clicking on a CrossRef link will be automatically connected to a page on the publisher's Web site showing a full bibliographical citation of the article, and, in most cases, the abstract as well. Subscribers are generally authenticated for full-text access, and non-subscribed users presented with other options for access (such as subscription, document delivery or pay-per-view). Researchers in library environments may find that CrossRef links redirect to local holdings. This development suggests that the publishers are approaching the errand of traditional secondary sources such as indexing and abstracting services, libraries and information centres. If cross-referencing between the diverse publishers becomes standard a new and potentially powerful information-searching tool may rise. Dalgaard (2001) addresses the perspectives of hypertext in the scholarly archives as a new organisational paradigm. He describes a shift in archival organisation moving from the traditional hierarchical tree-classification in paper-based archives towards an archive as a network of texts in the digital environment. This network "allows readers to ignore classifications and move directly between texts when it is convenient" (Dalgaard 2001, p. 183).

The virtual libraries can be used for detecting some formal communication units as well as most informal types. Lally (2001, p. 84) describes virtual libraries as "[b]ringing together the diverse kinds of information which researchers draw in during the process of doing and disseminating research, including things which were never found in the library in traditional sense, clearly makes sense in an electronic environment"[24].

Aids such as domain specific dictionaries, glossaries, taxonomies and thesaurus of various quality and coverage can be found on the Internet, mostly for free or as value-added service connected to fee-based databases, virtual libraries or clearinghouses. Seven examples of dictionaries or glossaries for the domain of life sciences can be found on the NBII Web site (www.nbii.gov/datainfo/onlineref/dictionaries). An example of a domain-specific taxonomy also for the life sciences is the Interagency Taxonomic Information System (ITIS) found at http://www.itis.uda.gov These secondary sources are both effectively and efficiently utilised on the Internet compared with traditional paper versions. However, the various sources must be individually assessed with regard to quality.

The documentary units of the Internet can also be reached by search engines or diverse meta search tools. Although very often helpful, these retrieval algorithms or search engines typically suffer from a lack of semantics on both the gathering and querying ends (Dornfest and Brickley, 2001). On the gathering side, search engines rarely make use of any available metadata[25] and Internet directories usually do not include slots for metadata in their online register forms. Therefore, the opportunities that lie within the use of metadata are lost and the user is left with the capabilities of diverse algorithms. The average search engine user has no influence or knowledge of the algorithms built-in biases (Hjørland, 2003). On the querying end, it is still virtually impossible to remove the ambiguity between concepts like "by" and "about" (Dornfest and Brickley, 2001). An example of this could be the queries "find me all articles written by person X" versus "find me anything about person X". Furthermore, the coverage of the various search engines is limited. Different search engines cover different parts of the Internet. As an example not all search engines index the content of PDF or Postscript. This means that if an extensive search is required several search engines must be employed.

In Figure 3 the various Internet searching tools (search engines/meta search engines and virtual libraries/directories/clearinghouses) are positioned collectively in the centre box. Please note the dotted line surrounding the searching tools symbolising that, although the box embraces all lines from producer to user none or all may be used in the user's information-seeking activity.

Conclusion

As shown in Figure 3 the Internet as a media does in fact include some kind of representation of nearly all the diverse organisational and documentary units presented in the original UNISIST model. The original organisational and documentary units of the UNISIST model are replaced with those of the Internet. However, only a few changes have been made to the overall structure to fit the Internet-based communication flow. The most influential changes found in the flow of Internet-based scholarly information (Figure 3) compared

with the original UNISIST model (Figure 1) are: the presence of preprint databases, and the box in the centre of the model containing various Internet searching tools (such as search engines/meta search engines and virtual libraries/directories/clearing houses). In addition the absence of data centres (as justified previously) must be noticed, as well as the somewhat different use of the term clearing houses when dealing with the Internet.

Furthermore, as stated by Smith (1999), the flow of computer-mediated communication can cause a modification of the traditional categorisation of documentary units in document types some of the documentary units to broaden or even modify their categorisation in document type (primary literature, secondary literature and tertiary literature), and has given raise to problems defining exactly when an Internet document is "published" or not. In the electronic environment it also becomes difficult to define the concept of documents itself. When is something an independent document and when is it only a part of a document[26]?

A suggestion for the integration of the Internet in the UNISIST model

A renewal of the UNISIST model must integrate the organisational and documentary units found on the Internet, since these have become significant in the scientific flow of communication. The flow of scientific communication is in a transition phase where both the computer mediated communication and the well-established traditional communication system (the left side of Figure 4) is often used for much the same purposes. Figure 4 thus must embrace both the more traditional communication channels (displayed at the left) and the later computer-mediated communication channels (displayed at the right).

Figure 4 contains the entire computer-mediated communication in a box where the various organisational and documentary units presented in Figure 3 are "floating" around with possible direct interaction with each of the elements – whereas the traditional communication channels (displayed at the left-hand side) has a somewhat more restricted flow.

Several researchers have pointed to the fact that each domain will adjust and take advantage of those aspects of the new media, which best fit into its social organisation (Russel, 2001; Hurd, 2000). Even years from now we will probably be able to find domains that do not adopt certain features made available by the Internet as a media (Kling and McKim, 2000; Kling *et al.*, 2003). In other domains, acceptance and use of computer-mediated communication will catch on more slowly as argued by Thompson (2002). Based on an analysis of citation patterns in the humanities, Thompson (2002, p. 12) finds that, in the humanities "[e]lectronic publishing is not generally considered a viable alterative to print publishing". However, a number of electronic publishing projects have been undertaken in the humanities (Thompson, 2002, p. 132), and Thompson believes that the citations are lacking due to the relatively long median citation age[27] found in the humanities. This means that the renewed UNISIST model

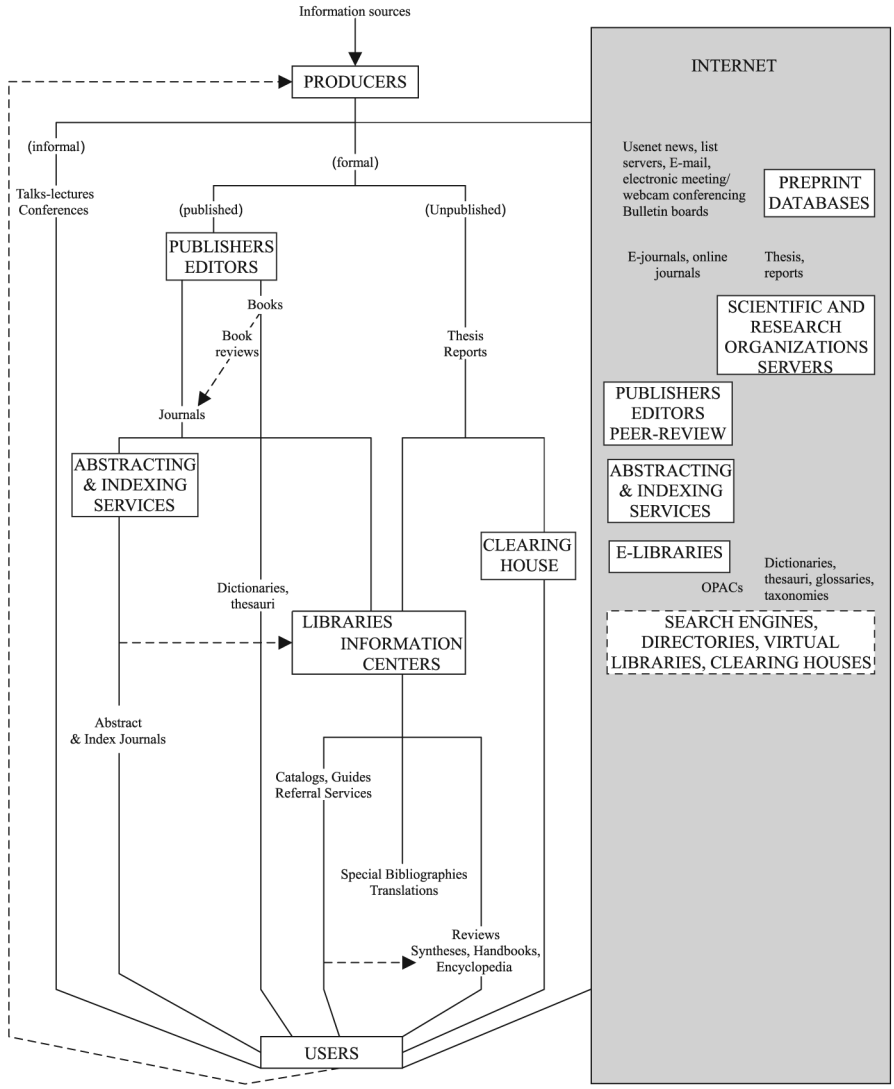


Figure 4.
The communication of scholarly information

may fit some domains better than others. It must therefore be a goal to describe different domains specific information flow and to examine to what extent each element is of value to that particular domain.

Some theoretical revisions of the UNISIST model

Considering the differences between domains

Figure 5 shows Figure 4 within a punctured ellipse symbolising a scientific discipline or a knowledge domain. The ellipse can symbolise, for example, the

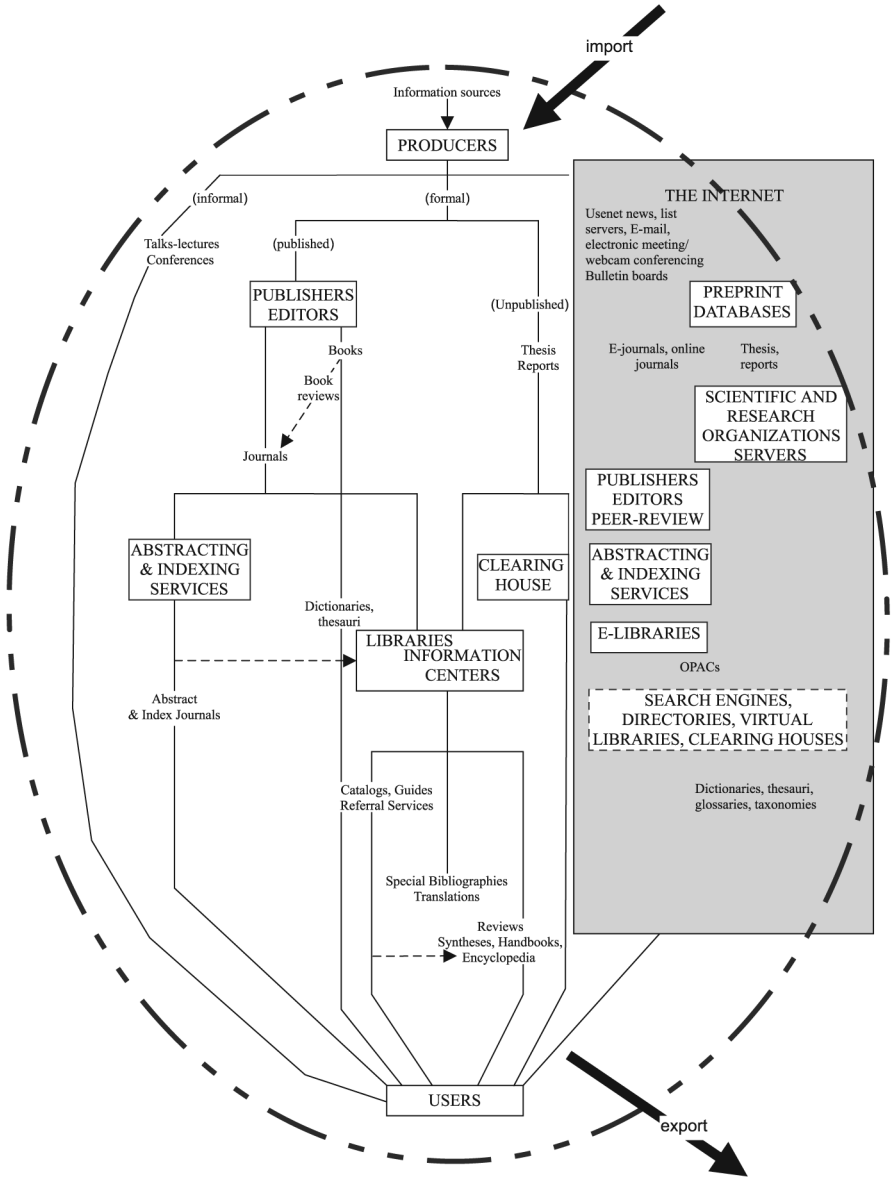


Figure 5.
The revised UNISIST model modified for the domain analytic approach

biological, the medical or the legal discourse community. Such domains are typically overlapping, open structures, as is the case in the biomedical domain, where the borders of biology and medicine are difficult to identify. The boundary of a domain is not tight, which is why the ellipse is (more or less) punctured. The knowledge producers, users and intermediaries are thus all

considered members of a discourse community. The domain itself reflects the division of labour in society (e.g. the division between those people working with health problems in the health domain and those working with legal problems in the legal domain). Inside each domain, there is a more or less developed internal division of labour, e.g. between theoretical and empirical researchers, assistants, administrators, librarians/information specialists[28], translators, publishers, practitioners, etc. Often the practitioners are the end-users of the knowledge produced by the researchers. This can, for example, be the doctor curing a patient by applying new research results.

Scientific and scholarly communication and information exchange should be perceived as processes in a more or less well-defined co-operative community working in order to solve given, common goals. Knowledge producers, intermediaries and users are seen as organised in thought and discourse communities, which are part of the division of labour in society.

The most important thing to realise is that every domain has its unique structure that should be described empirically and explained theoretically. A central point in the domain analytic approach to information science is the claim that tools, languages for special purposes (LSP), concepts, meaning, information structures, needs and relevance criteria are shaped in discourse communities. Different scientific, scholarly or professional domains have unique structures of communication and publication and unique types of documents. Each unique structure is an expression of an adaptation to the special needs in the domain. Hjørland (1997, p. 127) lists some examples of unique kinds of documents:

- In astronomy: almanacs.
- In engineering: patents.
- In geography: maps and atlases.
- In genealogy: pedigrees and genealogical trees.
- In law: codes; bodies of law.
- In music: sheets of music.
- In psychology: tests.

Domains – to a varying degree – also import knowledge from other domains and export knowledge to other domains[29]. With an expression from Whitley (2000), used about individual researchers, one can say that fields are more or less strategically dependent of knowledge produced in other fields. They also vary much in their imports and exports of interdisciplinary[30] knowledge and knowledge to the general public. The humanities typically have a much tighter relationship to the mass media and the general public compared with scientific publications.

Figure 6 shows how knowledge producers can get information from sources in their own domain, from other domains, from direct observation of natural

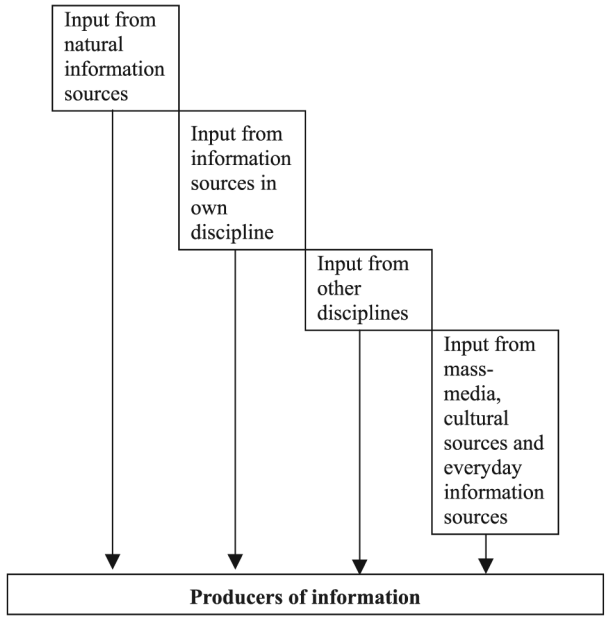


Figure 6.
Input to knowledge producers

information sources or from the general public. Some domains get most of their knowledge from their own domain. This is the case with mathematics, economics and psychology. Other domains such as agriculture get most of their input from other domains, e.g. from chemistry. Different epistemologies in a given domain will emphasise different knowledge sources[31]. Social constructivism is, for example, an epistemological position that claims that researchers' direct observations of nature are mediated by information sources of a social nature, which is a contrast to an empiricist or positivist epistemology.

Some scholarly fields have special information services providing prepared materials for research. This is especially the case in historical research. Archives and museums are important institutions missing in the original UNISIST model. They are very important in the humanities and may also be important in some scientific fields. The study of archives and museums is part of information science (see Hjørland, 2000; Ribeiro, 2001; McCrank, 2001). Often archives and other institutions reproduce and publish important historical documents in order to make such unique documents much more visible and available to scholars. This is a unique kind of documents, which should not be overlooked. In the Appendix we have added "source literature" as a new category beyond the primary, secondary, tertiary forms and other categories.

Figure 7 shows correspondingly different output channels from knowledge producers. In engineering physical products such as speakers or cars are the normal products from knowledge production (and as patents), while it is

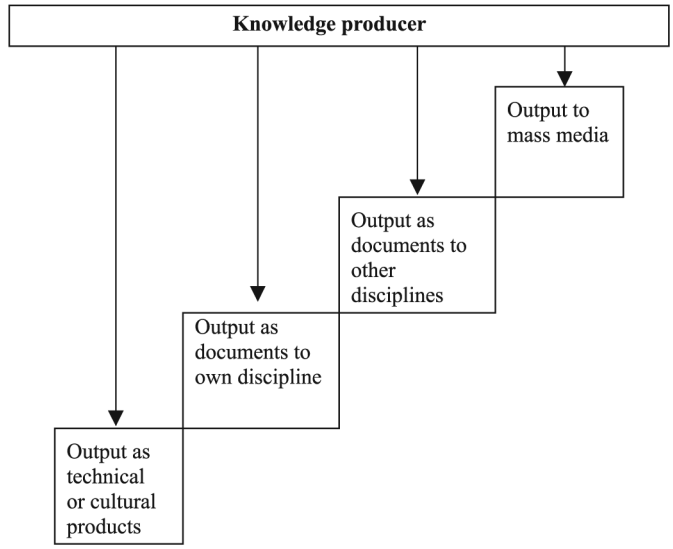


Figure 7.
Output from knowledge producers

journal articles in science and often books and cultural products in the humanities. Produced articles may be printed in journals in the researcher's own discipline or may be printed in journals related to other disciplines or in general scientific journals.

There may be many causes where the information structure in one domain differs from that in another domain. Some domains may, for example, have better economic resources to fulfil their needs for information services. Some disciplines do not have adequate libraries or bibliographical databases, but must rely on interdisciplinary libraries or databases. What is of much greater interest is, however, if there are essential differences, which is caused by inherent differences in the nature of the fields[32]. One example of such essential differences could be the relative degree of objectivity in science compared with the humanities. In the humanities the basic organisation of knowledge is often the individual authorship, and by implication very important "units" in the scholarly communication system are the collected works/critical editions of single writers. The works of a philosopher, for example, reflects many different subjects united by the subjective view of the author. The existentialist understanding of anxiety is thus deeply connected to the Kierkegaard's and other existential philosophers' worldview. The understanding of the subject matter in the humanities often goes through the understanding of the authors and their texts. By contrast, in science the presentation of the subject matter is mostly directly through a model or theory of the object of research. The single authors contribute to the knowledge in, say the database containing knowledge about the human genome. In science knowledge is not primarily organised in authorship or collected works, but is

scattered and fragmented in journal articles and cumulated and organised in more collective theories and models as well as in review articles and handbooks.

The more developed a scientific field is, the more should we expect a formalised division of functions within that field. Specialised information services and the delegation of information retrieval to information specialists are thus more common in scientific fields, while the information services in the social sciences tend to be the poor relation (Line, 1999; Hobohm, 1999). In the social sciences there is a tendency by many to imitate the research methods and organisational patterns from the sciences while others relate more to the humanities. The social sciences are thus split between two main tendencies, which also affect the communication structure in the field. Often databases, thesauri, annual reviews of progress, publications manuals, etc. are imported from the sciences, while some critics questions the value of such natural science norms in the social sciences information systems (e.g. Bazerman, 1988; Roberts, 1985). The ideal model of communication in knowledge fields thus depends on epistemological questions – why epistemology becomes of crucial importance for information science (see also the subsection entitled "Considering paradigmatic differences" below).

The further empirical description of the structures of actors and institutions in specific domains should be a fruitful area of development in information science. So should attempts to measure bibliometrically the relative importance of different channels. Also the further theoretical explanations of those empirical structures are important.

Considering geographical substructures

The original UNISIST model was conceived of as one universal international structure. In reality, however, there exist more or less independent and elaborated national or regional information substructures. If we take psychology as an example, there exist both international journals of psychology, US journals and, for example, German journals of psychology. The US journals tend to dominate. They are the most cited, and they are often conceived as international, although they may in reality be less international with respect to authorship and editorial boards than, for example, Scandinavian journals. Sivertsen (1994, p. 50) writes that the leading US sociological journals are not "international" because more than 90 per cent of their articles are from the USA. From a Scandinavian point of view he finds that it would be self-effacing to accept such a journal as international because in reality it is not open to, for example, Scandinavian researchers. One should thus not underestimate a corresponding Scandinavian journal, which may even show a higher percentage of foreign papers.

The German information system for psychology is the most elaborated information system outside the USA in this domain. In this system we find a

complete system of primary, secondary and tertiary information services. The primary information system in German psychology consists of journals covering all major subfields such as experimental psychology, social psychology, clinical psychology, developmental psychology and so on. It also consists of systems of conferences, books in all fields of psychology, scholarly treatises, about 150 publishers, producers of tests etc. The secondary information system contains a comprehensive bibliographical database, PSYNDEX, with abstracts and indexing of the German literature in both English and German. This database is fully compatible with the US database PsycINFO, and has a fully compatible thesaurus (bilingual: German and English). Also other kinds of dictionaries are developed. The tertiary information system contains comprehensive handbooks, encyclopaedias, review journals etc. It should be said that the German concept *Handbuch* is extraordinary and not just a translation of the English "handbook". The work *Encyclopädie der Psychologie* is such a systematic *Handbuch* of psychology planned in 88 comprehensive volumes, and is without counterpart in any other language. Also bibliometrical research on trends in German psychology produced by *Zentralstelle für Psychologische Information und Documentation* should be mentioned. The German system also contains specialised information systems developed to communicate psychological knowledge to students and to the general public. The magazine *Psychologie Heute* (which is a German version of the US magazine *Psychology Today*) is an example[33].

What are the meaning and implications of the existence of such geographical subsystems? There is today an increasing political pressure towards internationalisation. Such a pressure may motivate a German psychologist to publish in US (or international) journals, and it may leave the impression, that all such geographical substructures are obsolete and inappropriate. Before such a conclusion is reached, we need, however, to consider this question in much more detail.

The first thing to consider is the international coverage of bibliographic databases that claim to be international. Although it would be suitable to have one comprehensive, international database the reality is that the producers normally have to consider the cost of indexing the global literature. They have to balance their costs against the benefits and income caused by a comprehensive coverage of literature published in foreign languages. The low coverage of German psychology in *PsycINFO* is not caused by the existence of *Psyndex*. It is the other way round: the insufficient coverage of German psychological literature has forced the Germans to produce their own database. Most other countries in the world have tried the same thing, but have not had infrastructure to be able to maintain such databases, which is why their literature is underrepresented and less visible compared with US literature.

At the deeper level there is the question about the nature of different traditions in science and scholarship. From a positivist view of knowledge,

such traditions should be of no particular importance. Science should be unrelated to different cultures and political systems. Most philosophers of science today find, however, positivism to be wrong, and this might provide arguments for nationally- or regionally-based information systems. Connections between science and the political system have even been demonstrated empirically (Andersen, 1999, 2000). Of course the importance of different traditions connected with regional cultures varies strongly in different areas of science and scholarship, as also indicated by Andersen (2000) in relation to the social sciences. Such connections may be relatively weak in, for example, chemistry, and they may be relatively strong in, for example, psychology and the social sciences in general.

In general it is important to consider regional and cultural differences. This is important in relation to citation databases, which are used to evaluate researchers' productivity and influence. It is clearly problematic that, for example, European scientists and scholars are evaluated by their visibility in US databases, which are developed according to specific US norms and needs and with an insufficient coverage of European literature and European norms, views and needs[34].

Brittain (1984) wrote "The claims of the social sciences to be of universal interest, value, and use are challenged. Citation data show that there is not a free flow of information across language and national boundaries" and he considers the implication for information services. This is still an important issue.

Considering paradigmatic differences

In addition to disciplinary and geographical differences, each domain will have – more or less noticeably – variations in its information system that is due to paradigmatic differences between the actors in the field. In psychology, for example, there are almost a complete information system for the psychoanalytic approach to psychology, consisting of primary journals, specific organisations, specific indexes and abstracts journals, specific encyclopaedias and terminological works, etc. This system is not just relatively independent of the "general" psychological system, it also has attributes that reflect the special nature of that field. Thus psychoanalytic literature is more related to the humanities compared, for example, with the literature of behaviourism, cognitivism and neuroscience. This is reflected in the tendency to organise the literature into authorship (Sigmund Freud's works, C.G. Jung's works, Melanie Klein's works, etc). It is also reflected by the relative dominance of books relative to articles and by the rhetorical structure of the texts.

Although such paradigmatic tendencies may be very weak, it is our opinion that they always tend to exist to some extent. This can be explained by the theory of social semiotics, such as activity theory (Karpatschof, 2000).

Semiotics is the teaching about signs. For Charles Sanders Peirce (1839-1914) a sign is a triadic unit of something (the expression, e.g. a footprint), standing for somebody (the interpreter) for something else (the object, e.g. that a person has passed by). In activity theory the concept of tools is important. Tools have functional values in relation to certain cultures (or subcultures). According to activity theory meanings, signs and documents are functionally and historically developed to manage needs in relatively stable forms of practice in human societies. For example, we use the Bible and the hymnbook in our (relative stable) religious practice, we use body of laws in our relative stable legal practice, and we use textbooks in our relative stable teaching practice and so on. Concepts as well as documents have more or less stable meanings in relation to such applications. In a given community or discipline there are always more or less consensus regarding whether the existing practice is adequate or whether it should be changed. There will also be different opinions regarding whether the existing practice should be changed in one or another direction. One could say that in a given (sub)culture or domain there will almost always exist different "paradigms" for how practices should be changed and how the discipline should be defined and further developed. Any change in practices implies a need to change the documents, the symbolic systems and the concepts that support the existing practice. Given concepts and documents will always serve certain policies and practices better than other concepts and documents. This is the case whether or not people are aware of this relationship.

Different concepts, documents, ways of cooperation etc. are simply better suited for certain "paradigms" than for other paradigms. This is why there always is a more or less latent tendency to develop separate information systems for separate views in any field. Only some disciplines (e.g. psychology and economics) have, however, specific journals specially devoted to different views. The epistemological issues may, however, turn out to be the most important dynamics underlying any information system.

Conclusion

The UNISIST model is a fruitful model of scientific communication that helps conceptualise information science in a perspective that is of great heuristic value and also fruitful for further empirical investigations.

In this paper we have updated this model by considering developments in scholarly communication since 1971, with, first and foremost, the development of the Internet. We have also considered theoretical developments in information science with, first and foremost, the introduction of the domain analytic view. We consider the model extremely useful as well for synthesising the large amounts of fragmented empirical research as for inspiration to undertake further studies.

Today we do not even have a description of the communicative system for even one single discipline based on empirical studies. We also need to consider some basic issues in the model. For example, to what degree do the primary, secondary, tertiary, source producing and intermediating level (text books and mass media) function as relatively independent systems? Do they have relatively independent groups of professionals? Do they have specific guidelines and norms? Do they have specific channels for publication (output)? Do they have specific educational programmes and information input channels? What internal and external factors determine the structure of scientific communication systems?

Each point in the model as well as large number of relations is in need of more research. We plan to publish papers on primary, secondary, tertiary literatures, as well as on historical sources and other elements. It is our hope that this model may stimulate further interest in scholarly communication and in documents.

Notes

1. We have not been able to discover what the letters in this acronym stands for. The report itself says: "UNISIST: an acronymic term which stands for the feasibility study and for the recommended future programme to implement its recommendations" (UNISIST, 1971, preface, p. v).
2. Our overall praise of the UNISIST model as an analytic tool does not, however, imply that we agree in all the assumptions behind this project. Among the critics has McLean Lamberton (1983) pointed out that "UNISIST created an illusion of neutrality. Individual differences received inadequate attention, and the program's users were not identified. Overall, inequalities were accentuated rather than minimized."
3. Some documentation databases (e.g. ERIC and MEDLINE) operate on a non-profit base. We may further make a distinction between for profit institutions (e.g. Institute for Scientific Information: ISI; governmental non-profit institutions like major societies such as Amercian Chemical Society, American Psychological Association, American Society for Information Science and Technology, etc.). Even though such societies are official non-profit organizations, their actual information services may well operate in ways close to the ways for profit organizations operate (and vice versa). The whole question about the development and influence of commercial principles versus non-commercial principles in the scientific communication system seems so far not to have been addressed in the LIS at all.
4. An example is theTechnical Knowledge Center of Denmark (http://www.dtv.dk/index_e.htm).
5. The UNISIST-report actually mentions this as an example of a clearinghouse. But the activity of CFSTI or ERIC for that matter is not restricted to unpublished documents.
6. Of the 5,748 journals assessed by impact factor by the Institute for Scientific Information, the *Annual Review of Immunology* is ranked no. 1, *Annual Review of Biochemistry* is ranked no. 3, and over one-third of the Annual Reviews titles are in the top 100 regardless of category. Source: http://www.annualreviews.org/catalog/isi_rankings.asp
7. Our additions are found in Figure 4.
8. A peculiar feature of the model at this point is that it apparently considers letters to the editors as part of the informal mode of scientific communication. We do not find this

appropriate and regard letters to the editors as belonging to the category of primary literature. This seems to be supported by the literature on the topic. Hyland (2000, pp. 85-103) is an example of research that has examined the letter genre and its crucial function in scientific communication for scientific fields as physics, chemistry and microbiology.

9. Fleck (1979, p. 39) defines a thought collective as "... a community of persons mutually exchanging ideas or maintaining intellectual interaction".
10. Thought style is defined by Fleck (1979, p. 99) as "... the readiness for directed perception, with corresponding mental and objective assimilation of what has been so perceived."
11. Various terms and acronyms are used in the literature to define this group of communication channels. For this purpose Internet-based communication channels broadly define sources available via the Internet as for example e-mail, List servers, Usenet Newsgroups, e-journals, databases, directories and search engines.
12. Lawrence (2001) indicated that the visibility of online papers are much higher than that of printed papers. ResearchIndex. CiteSeer (http://www.neci.nec.com/~lawrence/researchindex.html) is a kind of Internet-based citation index.
13. See for example the ETAI experience where the fundamental idea is open reviewing with an open discussion (Sandewall, 1998).
14. The survey found that physicists and mathematicians were the earliest users and experimental biology the most recent. NB: the survey included only four research areas. Research made by Bridges and Clement (1997) found that scholars from the humanities rather late adopted e-mail.
15. According to a survey made by Zhang in 1998 74 per cent of the respondents used list servers at least two to three times a week while only 22 per cent of the respondents used Usenet news in the same period of time and 30 per cent did not use them at all (Zhang, 2001 p. 634).
16. In short often simply termed the ARL directory. ARL is an abbreviation for the Association for Research Libraries. Previous directories can be viewed free of charge at: http://dsej.arl.org/scomm/edir/archive.html See Mogge (1999, 2000) for further information about the directory.
17. For instance: http://lib-www.ucr.edu">http://www.clearinghouse.net, http://lib-www.ucr.edu, http://sunsite.berkeley.edu/internetindex">http://www.ipl.org, http://sunsite.berkeley.edu/internetindex or http://vlib.stanford.edu/Overview.html
18. See Weller (2001) for pervasive studies of peer review in diverse disciplines.
19. Digitising back issues of journals and canonical texts.
20. "In eprint archives researchers communicate exclusively via research abstracts that describe material otherwise suitable for conventional publication. This is a very formal mode of communication in which each entry is archived and indexed for retrieval at arbitrary later times" (Ginsparg, 1996, p. 3).
21. EAGLE is a non-profit association who seeks to create a co-operative network for identification location and supply of grey literature.
22. SIGLE is a bibliographic database available online given a password.
23. See http://crossref.org for further detail.
24. Lally (2001) mentions conference announcements and calls for papers, job advertisements, e-mail, preprint servers and newsgroups.
25. Metadata elements such as The Dublin Core are often disregarded by the robots or spiders and search engines provide little room for registering metadata along with their sites (Dornfest and Brickley, 2001).

26. For further discussion of the concept of a digital document see for example a preprint authored by Buckland available at the Web site: http://www.sims.berkeley.edu/~buckland/digdoc.html
27. The median citation age found by Thompson (2002) was 13 years.
28. Librarians working in a specific domain are special librarians, as opposed to general librarians working in public libraries (although even librarians in public libraries may specialise, e.g. in music librarianship). From the point of view of the domain, they are serving special librarians should have adequate subject knowledge and specific knowledge about the databases, terminology, and communicative structure in the domain they work in. Unfortunately, I consider it an historical fact that the library profession at large has mostly neglected this need (see, e.g. Williams, 1997). In my opinion, the domain analytic approach, emphasising differences in knowledge domains and the need to some kind of subject-specialisation should be fruitful even for general librarianship.
29. Such imports and exports can be studied bibliometrically. This has been done by, among others, Cronin and Pearson (1990).
30. Concerning problems of interdisciplinary knowledge use, see Klein (1990).
31. This is demonstrated empirically in Hjørland (2002a).
32. One of the most recognised sociological theories explaining the different organisational structures of knowledge fields is that of Whitley (2000).
33. Bibliometrical studies of the German national information system and debates concerning internationalisation can be found in Becker (1984, 1994), Keul *et al.* (1993, 1994), Krampen *et al.* (2002a, b), Lienert (1977), Montada *et al.* (1995), Montada and Krampen (2001), Nussbaum and Feger (1978), Schui *et al.* (2002), Tack (1994) and Traxel (1975, 1977).
34. This has especially been recognized by the European Science Foundation in the case of the humanities. In 2001 were held a conference about research evaluation in the humanities and the need to establish a European citation database for the humanities.

References

Ackermann, E. and Hartman, K. (1998), *The Information Specialist's Guide to Searching and Researching on the Internet and The World Wide Web*, ABF Content, Wilsonville, OR.

Andersen, H. (1999), "Political attitudes and cognitive convictions among Danish social science researchers", *Scientometrics*, Vol. 46 No. 1, pp. 87-108.

Andersen, H. (2000), "Influence and reputation in the social sciences – how much do researchers agree?", *Journal of Documentation*, Vol. 56 No. 6, pp. 674-92.

Andersen, J. (2002), "The role of subject literature in scholarly communication: an interpretation based on social epistemology", *Journal of Documentation*, Vol. 58 No. 4, pp. 463-81.

Arms, W.Y. (2000), *Digital Libraries*, MIT Press, Cambridge, MA.

Bazerman, C. (1988), *Shaping Written Knowledge: The Genre and Activity of the Experimental Article in Science*, University of Wisconsin Press, Madison, WI, available at: http://aw.colostate.edu/books/bazerman_shaping/main.htm

Becker, J.H. (1984), "Wissenschaftssprache Nummer eins", *Transfer*, No. 15, pp. 116-8.

Becker, J.H. (1994), "Publizieren deutsche Psychologen zunehmend in englischer Sprache?", *Psychologische Rundschau*, Vol. 45, pp. 234-8.

Blumberg, H.H., French, C.C. (Eds) (1991), *Peace: Abstracts of the Psychological and Behavioral Literature*, APA, Washington, DC.

Bridges, A.E. and Clement, R.T. (1997), "Crossing the threshold of rocket mail: e-mail use by US humanities faculty", *Journal of Academic Librarianship*, Vol. 23 No. 2, pp. 109-17.

Brier, S., Dyrbye, M., Graulund, J., Koggersbøl Hansen, I., Hjørland, B., Vind, T. and Ørum, A. (1997), *Faglitteraturens dokumenttyper i kommunikations- og videnskabsteoretisk belysning. Kategorier, medier, former, genrer, niveauer and kvaliteter*, preliminary edition, The Royal School of Library and Information Science, Copenhagen, Vol. 1-2, p. 6.

Brittain, J.M. (1984), "Internationality of the social sciences: implications for information transfer", *Journal of the American Society for Information Science*, Vol. 35 No. 1, pp. 11-18.

Cronin, B. and Pearson, S. (1990), "The export of ideas from information science", *Journal of Information Science*, Vol. 16 No. 6, pp. 381-91.

Dalgaard, R. (2001), "Hypertext and the scholarly archive – intertexts, paratexts and metatexts at work", in *Proceedings of the Twelfth ACM Conference on Hypertext and Hypermedia, August 14-18, Aarhus, Denmark*, ACM Press, New York, NY, pp. 175-184.

Dornfest, R. and Brickley, D. (2001), "The power of metadata", *The O'Reilly Network*, 18 January, available at: www.openp2p.com/1pt/a/554 (accessed 13 February 2003).

Fix, D. *et al.* (1964), *Some Characteristics of the Review Literature in Eight Fields of Science*, Herner and Co., Washington, DC.

Fleck, L. (1979), *Genesis and Development of a Scientific Fact*, Trenn, T.J. and Merton, R.K. (Eds), trans. by Bradley, F. and Trenn, T.J., Foreword by Thomas S. Kuhn, The University of Chicago Press, Chicago, IL.

Garfield, E. (1982), "ISI's new Index to Scientific Reviews (ISR) – applying research front speciality searching to the retrieval of the review literature", *Current Contents*, No. 39, pp. 5-12.

Garfield, E. (1987a), "Reviewing review literature 1. Definitions and uses of reviews", *Current Contents*, No. 18, pp. 3-6.

Garfield, E. (1987b), "Reviewing review literature 2. The place of reviews in the scientific literature", *Current Contents* No. 19, pp. 3-8.

Garvey, W.D. and Griffith, B.C. (1972), "Communication and information processing within scientific disciplines: empirical findings for psychology", *Information Storage and Retrieval*, Vol. 8, pp. 123-36.

Ginsparg, P. (1996), "Winners and losers in the global research village", invited contribution for conference held at UNESCO HQ, Paris, 19-23 February 1996, available at: http://arxiv.org/blurb/pg96unesco.html

Goodrum, A.A., McCain, K.W., Lawrence, S. and Giles, C.L. (2001), "Scholarly publishing in the Internet age: a citation analysis of computer science literature", *Information Processing and Management*, Vol. 37 No. 6, pp. 661-75.

Grey Literature Network Service (1999), *GL 1999 Conference Program. Fourth International Conference on Grey Literature: New Frontiers in Grey Literature. GreyNet*, Grey Literature Network Service, Washington, DC, 4-5 October, available at: www.nyam.org/library/greylit/whatis.shtml (accessed 17 February 2003).

Harnad, S. (1991), "Post-Gutenberg galaxy: the fourth revolution in the means of production of knowledge", *Public Access Computer Systems Review*, Vol. 2 No. 1, pp. 25-38.

Harter, S.P. (1998), "Scholarly communication and electronic journals: an impact study", *Journal of the American Society for Information Science*, Vol. 49 No. 6, pp. 507-16.

Hitchcock, S., Carr, L. and Hall, W. (1996), "A survey of STM online journals 1990-95: the calm before the storm", in Mogge, D. (Ed.), *Proceedings Directory of Electronic Journals, Newsletters and Academic Discussion Lists*, pp. 7-32.

Hjørland, B. (1997), *Information Seeking and Subject Representation. An Activity-theoretical Approach to Information Science*, Greenwood Press, Westport, CT and London.

Hjørland, B. (2000), "Documents, memory institutions, and information science", *Journal of Documentation*, Vol. 56 No. 1, pp. 27-41.

Hjørland, B. (2002a), "Domain analysis in information science: eleven approaches – traditional as well as innovative", *Journal of Documentation*, Vol. 58 No. 4, pp. 422-62.

Hjørland, B. (2002b), "Epistemology and the sociocognitive perspective in information science", *Journal of the American Society for Information Science and Technology*, Vol. 53 No. 4, pp. 257-70.

Hjørland, B. (2003), "Aware and responsible", in Rayward, B., Hansson, J. and Suominen, V. (Eds), *Social and Cultural Awareness and Responsibility in Library, Information and Documentation Studies*, Scarecrow Press, Lanham, MD (in press).

Hjørland, B. and Albrechtsen, H. (1995), "Toward a new horizon in information science: domain analysis", *Journal of the American Society for Information Science*, Vol. 46 No. 6, pp. 400-25.

Hobohm, H.-C. (1999), "Social science information and documentation – time for a state of the art?", *Inspell*, Vol. 33 No. 3, pp. 123-30.

Hurd, J.M. (1996), "Models of scientific communication system", in Crawford, S.Y., Hurd, J.M. and Weller, A.C. (Eds), *From Print to Electronic: The Transformation of Scientific Communication*, ASIS, Medford, NJ.

Hurd, J.M. (2000), "The transformation of scientific communication: a model for 2020", *Journal of the American Society for Information Science*, Vol. 51 No. 14, pp. 1279-83.

Hyland, K. (2000), *Disciplinary Discourses. Social Interactions in Academic Writing*, Pearson Education, Harlow.

Karpatschof, B. (2000), *Human Activity. Contributions to the Anthropological Sciences from a Perspective of Activity Theory*, Dansk Psykologisk Forlag, Copenhagen.

Keul, A.G., Gigerenzer, G. and Stroebe, W. (1993), "Wie international ist die Psychologie in Deutschland, Österreich und der Schweiz? Eine SSCI-analyse", *Psychologische Rundschau*, Vol. 44 No. 4, pp. 259-69.

Keul, A.G., Gigerenzer, G. and Stroebe, W. (1994), "Publicationen in internationalen Zeitschriften: Ein Nachworth zur SSCi-analyse", *Psychologische Rundschau*, Vol. 45 No. 2, pp. 111-3.

Keyhani, A. (1993), "The online journal of current clinical trials: an innovation in electronic journal publishing", *Database*, Vol. 16 No. 1, pp. 14-23.

Klein, J.T. (1990), *Interdisciplinarity. History, Theory and Practice*, Wayne State University Press, Detroit, MI.

Kling, R. and Callahan, E. (2003), "Electronic journals, the Internet, and scholarly communication", *Annual Review of Information Science and Technology*, Vol. 37, pp. 127-77.

Kling, R. and McKim, G. (2000), "Not just a matter of time: field differences and shaping of electronic media in supporting scientific communication", *Journal of the American Society for Information Science*, Vol. 51 No. 14, pp. 1306-20.

Kling, R., McKim, G. and King, A. (2003), "A bit more to it: scholarly communication forums as socio-technical interaction networks", *Journal of the American Society for Information Science and Technology*, Vol. 27, p. 2002.

Krampen, G., Montada, L. and Schui, G. (2002a), "Internationalität und Internationalisierung der deutschsprachigen Psychologie im Zeitvergleich", in Krampen, G. and Montada, L. (Eds), *Wissenschaftsforschung in der Psychologie*, Hogrefe, Göttingen, pp. 121-36.

Krampen, G., Montada, L. and Schui, G. (2002b), "ZPID-Monitor 1999-2000 zur Internationalität der Psychologie aus dem deutschsprachigen Bereich: Ausführlicherer Bericht", *Fach bereich I – Psychologie and Zentrum für Psychologische Information und Dokumentation*

(ZPID) an der Universität Trier, Universität Trier, available at: ftp://ftp.zpid.de/pub/info/zpid-monitor.pdf

Lally, E. (2001), "A researcher's perspective on scholarly communication", *Online Information Review*, Vol. 25 No. 2, pp. 80-7.

Lancaster, F.W. (1978), *Toward Paperless Information Systems*, Library and Information Science Series, Academic Press, New York, NY.

Lancaster, F.W. (1998), *Indexing and Abstracting in Theory and Practice*, 2nd ed., Library Association, London.

Lawrence, S. (2001), "Online or invisible?", *Nature*, Vol. 411 No. 6837, p. 521, available at: www.neci.nec.com/~lawrence/papers/online-nature01/ (accessed 17 December 2002).

Lienert, G.A. (1977), "Über Werner Traxel: Internationalität oder Provinzialismus, zur Frage: Sollten Psychologen in Englisch publizieren?", *Psychologische Beiträge*, Vol. 19, pp. 487-92.

Light, R.J. and Pillemer, D.B. (1984), *Summing up: The Science of Reviewing Research*, Harvard University Press, Cambridge, MA.

Lindholm-Romantschuk, Y. (1998), *Scholarly Book Reviewing in the Social Sciences and Humanities: The Flow of Ideas within and among Disciplines*, Contributions in Librarianship and Information Science, Greenwood Press, Westport, CT.

Line, M.B. (1999), "Social science information – the poor relation?", *Inspell*, Vol. 33 No. 3, pp. 131-6.

Luzi, D. (1997), "The Internet as a new distribution channel of scientific grey literature: the case of Italian WWW servers", *Publishing Research Quarterly*, Vol. 13 No. 2, pp. 33-47.

McCrank, L.J. (2001), *Historical Information Science: An Emerging Unidiscipline*, Information Today, Medford, NJ.

McLean Lamberton, D. (1983), "Information, organization, and development policy", *The Information Society. An International Journal*, Vol. 2 No. 1, pp. 35-51.

Manzer, B.M. (1977), *The Abstract Journal, 1790-1920. Origin, Development and Diffusion*, The Scarecrow Press, Metuchen, NJ.

Marron, H. (1971), "Clearinghouses", in Kent, A. and Lancour, H. (Eds), *Encyclopedia of Library and Information Science*, Marcel Dekker, New York, NY, Vol. 5, pp. 196-7.

Meadows, A.J. (1998), *Communicating Research*, Academic Press, New York, NY.

Mogge, D. (1999), "Seven years of tracking electronic publishing: the ARL Directory of electronic journals, newsletters and academic discussion lists", *Library Hi Tech*, Vol. 17 No. 1, pp. 17-25.

Mogge, D. (2000), "New directory tracks scholarly e-journals and discussion lists", 16 December, available at: www.arl.org/newsltr/213/dsej.html (accessed 17 February 2003).

Montada, L. and Krampen, G. (2001), "Internationalität und Internationalisierung der deutschsprachigen Psychologie", in Silbereisen, R. and Frey, D. (Eds), *Perspektiven der Psychologie*, Beltz, Weinheim.

Montada, L., Becker, J., Schoepflin, U. and Baltes, P.B. (1995), "Die internationale Rezeption der deutschsprachigen Psychologie", *Psychologische Rundschau*, Vol. 46, pp. 186-99.

Nussbaum, A. and Feger, H. (1978), "Analyse des deutschsprachigen psychologischen zeitschriftensystems", *Psychologische Rundschau*, Vol. 29, pp. 91-112.

Peek, R.P. and Pomerantz, J. (1998), "Electronic scholarly journal publishing", *Annual Review of Information Science and Technology*, Vol. 33, pp. 321-56.

Piternick, A.B. (1989), "Attempts to find alternatives to the scientific journal: a brief review", *The Journal of Academic Librarianship*, Vol. 15 No. 5, pp. 260-6.

Ribeiro, F. (2001), "Archival science and change in the paradigm", *Archival Science*, Vol. 1 No. 3, pp. 295-310.

Roberts, N. (1985), "Concepts, structures and retrieval in the social sciences up to c. 1970", *Social Science Information Studies*, Vol. 5, pp. 55-67.

Rogers, E.M. (1995), *Diffusion of Innovations*, 4th ed., The Free Press, New York, NY.

Russel, J.M. (2001), *Scientific Communication at the Beginning of the Twenty-first Century*, UNESCO, Paris, pp. 271-82.

Sandewall, E. (1998), *Scientific Communication on the Internet. The ETAI Experience*, available at: www.ida.liu.se/ext/1998/01/

Sauter, H.E. (1971), "Clearinghouse for federal scientific and technical information", in Kent, A. and Lancour, H. (Eds), *Encyclopedia of Library and Information Science*, Marcel Dekker, New York, NY, Vol. 5, pp. 190-96.

Schui, G., Krampen, G. and Montada, L. (2002), "Zur Internationalität der Differentiellen Psychologie und Persönlichkeitsforschung aus dem deutschsprachigen Bereich", *Zeitschrift für Differentielle und Diagnostische Psychologie*, Vol. 23 No. 1, pp. 3-12.

Sivertsen, G. (1994), "Når er et tidsskrift internasjonalt?", in Gleditsch, N.P., Enckell, P.H. and Burchardt, J. (Eds), *Det vitenskapelige tidsskrift*, TemaNord,1994:574, Nordisk Ministerråd, Copenhagen.

Smith, A. (1999), "The journal as an overlay on preprint databases", talk prepared for ALPSP, 9 April 1999, available at: http://ridge.aps.org/APSMITH/ALPSP/talk.html

Spang-Hanssen, H. (2001), "How to teach about information as related to documentation?", *Human IT*, No. 1, available at: www.hb.se/bhs/ith/1-01/hsh.htm

Straub, D.W. and Beath, C.M. (1991), "The integrated information center concept", *Journal of the American Society for Information Science*, Vol. 42 No. 2, pp. 128-31.

Tack, W.H. (1994), "Bericht über Reaktionen auf einen Bericht: Zu Keul, Gigerenzer und Stroebes SSCI-Analyse", *Psychologische Rundschau*, Vol. 45 No. 2, pp. 108-11.

Thompson, J.W. (2002), "The death of the scholarly monograph in the humanities? Citation patterns in literary scholarship", *Libri*, Vol. 52, pp. 121-36.

Traxel, W. (1975), "Internationalität oder Provinzialismus? Über die Bedeutung der deutschen Sprache für deutschsprachige Psychologen", *Psychologische Beiträge*, Vol. 17, pp. 584-94.

Traxel, W. (1977), "'Publish or perish!' – auf deutsch oder auf englisch?", *PsychologischeBeiträge*, Vol. 21, pp. 62-77.

UNISIST (1971), *Study Report on the Feasibility of a World Science Information System, by the United Nations Educational, Scientific and Cultural Organization and the International Council of Scientific Unions*, UNESCO, Paris.

Walsh, J.P., Kucker, S., Maloney, N. and Gabbay, S.M. (1999), *Connecting Minds: CMC and Scientific Work*, available at: http://tigger.uic.edu/~jwalsh/JASIS.jw (accessed 17 February 2003).

Weller, A.C. (2000), "Editorial peer review for electronic journals: current issues and emerging models", *Journal of the American Society for Information Science*, Vol. 51 No. 14, pp. 1328-33.

Weller, A.C. (2001), *Editorial Peer Review: Its Strengths and Weaknesses*, Information Today, Medford, NJ.

Whitley, R. (2000), *The Intellectual and Social Organization of the Sciences*, Clarendon Press, Oxford (originally published in 1984).

Williams, R.V. (1997), "The documentation and special libraries movement in the United States, 1910-1960", *Journal of the American Society for Information Science*, Vol. 48 No. 9, pp. 775-81.

Wilson, P. (1968), *Two Kinds of Power. An Essay on Bibliographical Control*, University of California Press, Berkeley, CA.

Woodward, A.M. (1977), "The roles of reviews in information transfer", *Journal of the American Society for Information Science*, Vol. 28 No. 3, pp. 175-80.

Zhang, Y. (2001), "Scholarly use of Internet-based electronic resources", *Journal of the American Society for Information Science*, Vol. 52 No. 8, pp. 628-54.

Further reading

Andersson, M. and Skot-Hansen, D. (1994), *Det Lokale Bibliotek – Afvikling eller Udvikling*, The Royal School of Library and Information Science, Copenhagen.

Brown, C.M. (1999), "Electronic seeking behavior of scientists in the electronic information age: astronomers, chemists, mathematicians, and physicists", *Journal of the American Society for Information Science*, Vol. 50 No. 10, pp. 929-43.

Crawford, S.Y., Hurd, J.M. and Weller, A.C. (1996), *From Print to Electronic. The Transformation of Scientific Communication*, ASIS, Medford, NJ.

Hjørland, B. (1998), "Theory and metatheory of information science. A new interpretation", *Journal of Documentation*, Vol. 54 No. 5, pp. 606-21.

Marx, W. (1989), "Bemerkungen zum Sprachenstreit in der deutschen Psychologie", *Psychologische Rundschau*, Vol. 40 No. 2, pp. 89-92.

Roth, G. (1989), "Anmerkungen zu den 'Bemerkungen zum Sprachenstreit in der deutschen Psychologie' von Wolfgang Marx", *Psychologische Rundschau*, Vol. 40 No. 2, pp. 94-6.

Sanders, A.F. (1989), "Some comments on Marx 'Bemerkungen zum Sprachenstreit in der deutschen Psychologie'", *Psychologische Rundschau*, Vol. 40 No. 2, pp. 93-4.

UNESCO (2002), *UNISIST Newsletter*, Vol. 30 No. 1, available at: http://unesdoc.unesco.org/ulis (accessed 17 February 2003).

Weingart, P. (1989), "Ist der Sprachenstreit ein Streit um die Sprache?", *Psychologische Rundschau*, Vol. 40 No. 2, pp. 96-8.

Appendix. Typology of documents

I. Primary literature

Primary literature is the researcher's and knowledge producer's primary medium for claiming original findings, theoretical analysis, empirical data etc.:

- Monographs/"Polygraphs" (including series of monographs as long as they communicate original findings).
- Journal articles (as long as they communicate original findings).
- Critical-analysing reviews.
- Conference presentations.
- "Grey" literature, including: dissertations, treatises, master theses, reports, kinds of official publications, kinds of governmental publications.
- Patents.
- Standards.

Ia. Source literature
Source literature is either literature produced in order to supply researchers with information (e.g. translation journals) or information produced to other purposes than research, but used as information by researchers (e.g. music and fiction). Primary literature (and anything else) serves of course as information sources, why source literature is negatively defined as not being primary, secondary, tertiary, accidental or populating literature):

- Facsimiles.
- Transcriptions.
- Source editions, scientific editions, and standard editions. (Model: the works of Søren Kierkegaard.)
- Laws, court findings.
- Music.
- Data archives.
- Statistical documents, tabular documents (1) (reporting original data).
- Translations (only qua translations; the translated work is, for example, primary literature).
- Product information/"trade literature".
- (Not applicable: Sourcebooks).

II. Secondary literature/bibliographical literature
This is literature that registers, describes and organises the primary literature as well as the other categories (including the secondary literature itself). Secondary information systems are the core focus of the library, documentation, and information science profession. Bibliography is a discipline that studies this area:

- Subject bibliographies and bibliographical databases.
- Abstract journals.
- Indexes.
- Citation indexes.
- Current contents.
- Bibliographical guides, metabibliographies.
- Bio-bibliographies/author-encyclopaedias (including auto-bibliographies on personal Web-pages).
- Source inventories.
- Catalogues

IIa. Dictionaries and thesauri
Dictionaries are the focus of the linguistic subdiscipline lexicography. Thesauri are kinds of dictionaries that have mostly been studied and developed in relation to bibliographical databases:

- Historical/etymological dictionaries.
- Translation dictionaries.
- Conceptual dictionaries and thesauri.

III. Tertiary literature/review literature/"outlines"
This is literature summarising and synthesising knowledge in the primary literature:

- Handbooks.
- (Textbooks).
- Monographs/polygraphs 2 (synthesising existing literature without providing new, independent knowledge).
- Review articles (do).
- Scientific encyclopaedias (general encyclopaedias are normally popularisations).
- Short, indicative reviews.
- Chronological surveys.
- Data handbooks, tabular documents 2 (synthesising original statistical sources).

IV. "Incidental information"
Information about tools (including computers and software), about developments in the job market, in the discipline/domain, etc. as long as such information cannot be seen as part of the domain's regular knowledge production:

- Biographical documents.
- Directories.
- Conference calendars.
- Lists of archives.
- Directory to grants, scholarships etc.
- Yearbooks (annual reports).
- Newsletters.
- Personal homepages.

V. Popularisations
Export of knowledge produced in a domain to the general public, to other domains or to students:

- Textbooks.
- Magazines.
- Newspapers (e.g. science journalism).
- Popular books (including general encyclopaedias).
- Faction, science fiction.
- Mass media, multimedia presentations etc.