Chapter 9

STM Information

9.1 Information in Science, Technology and Medicine

The term "STM information" summarizes the totality of all knowledge from

- Science,
- Technology and
- Medicine.

This concerns the full texts of the documents in question as well as their bibliographic references, including metadata (Stock & Stock, 2008, Ch. 6) as well as STM facts (Stock & Stock, 2008, Ch. 7). Figure 9.1 provides an overview of the different products of digital STM information.

The **documents** can be separated into the following groups:

- articles in journals with Peer Review,
- articles in journals without Peer Review,
- contributions to proceedings of conferences (generally with Peer Review),
- books, patents and utility models.

A fundamental element of scientific-technical-medicinal publishing is Peer Review. This is a process of anticipated quality assurance and consists of assessing the scripts prior to their publication. Assessment as a legal act is practiced for patents, which are only granted after a thorough examination.

The world's most comprehensive database on periodicals, Ulrichsweb, currently holds more than 300,000 magazine titles. However, among them are journals without any STM characteristics. British Library holds around 40,000 titles of ongoing STM magazines (Stock, 2009). As this institution does not subscribe to all journals with STM content, this figure will serve as a lower estimate for the total amount of STM periodicals. Among them, around 25,000 are academic STM magazines in the narrow sense (i.e. those with continuous Peer Review) (Ng, 2009, 31). Apart from niche disciplines or smaller publication languages, most magazine articles are available in digital form–next to their print versions, which generally appear alongside them. Ng (2009, 31) reports of around 17,000 digital magazines (as of 2009), a number that is steadily rising.

The case is similar for contributions to conferences and eBooks. For the documents of technical protective rights (patents and utility models), we can assume–at least for the big industrial countries–the existence of complete databases, which hold the full text of all documents, unbroken from patent N° 1 to the current status. Apart from formal communication in magazines, conference contributions, books and protective rights documents, there also exist in STM informal channels such as cooperation between colleagues, mailing lists, message boards, weblogs, news groups etc. Apart from certain humanistic research areas, STM research today, in the age of "Big Science" (Solla Price, 1963), is mainly accomplished in teams.

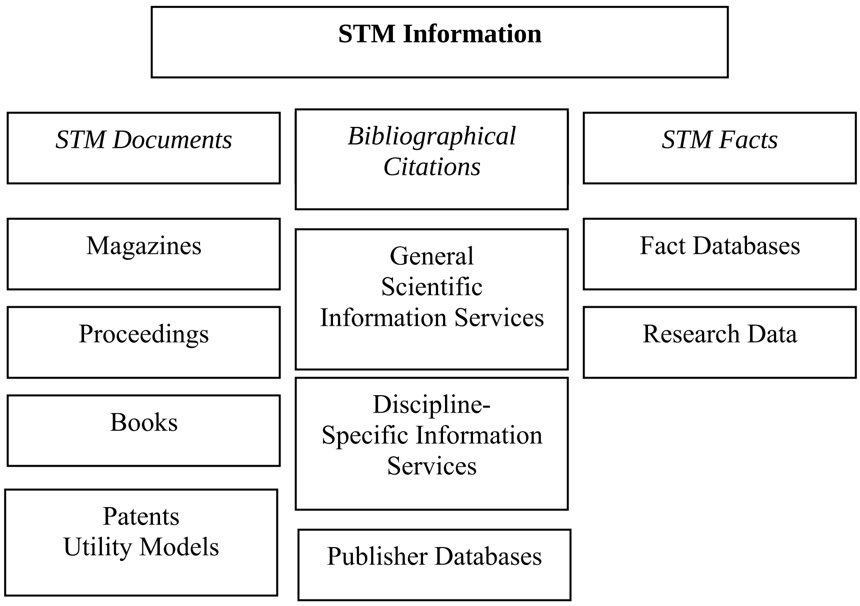

Figure 9.1: Classification of the Digital Goods of STM Information.

Bibliographic references–currently offered online throughout–are found in the following information products:

- general scientific information services (with no restrictions to scientific disciplines, like Web of Knowledge or Scorpus),
- discipline-specific literature databases (e.g. Chemical Abstracts for chemistry, INSPEC for physics or Compendex for engineering science),

- publisher databases (with references for their own articles and books, such as Elsevier's Science Direct or SpringerLink).

These are joined by information resources with **STM facts**, which are on the one hand, in the context of e-science ("enhanced science"), databases with research data that could not be included in the publications (due to a lack of space), and specific fact databases on the other (e.g. Beilstein for organic chemistry or Gmelin for inorganic chemistry).

There also exist, in the World Wide Web as well as the Deep Web (Stock, 2007, 108-111) search tools that specialize on STM information. These products will be discussed in Chapter 10.

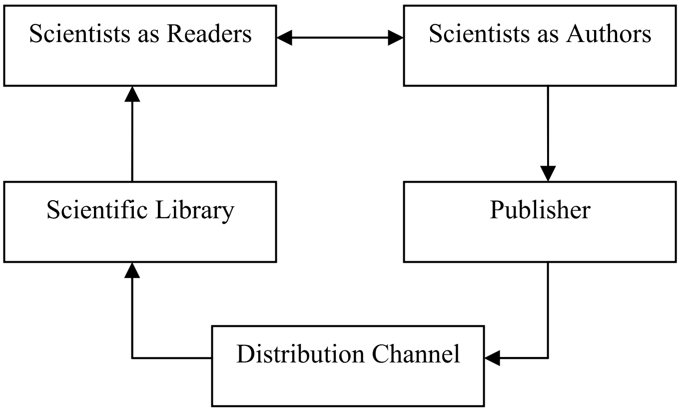

Figure 9.2: Value Chain of STM Information. Source: by analogy with Ball, 2004, 416.

The **value chain** of STM information (Figure 9.2) has a surprising–when compared to other economic value chains–characteristic: the producers are also the consumers. Scientists write for scientists, scientists read what colleagues have written. As profit-oriented publishers are involved in the value chain, this results in a "suspenseful" constellation: the science system must buy back its own results–sometimes at relatively high prices.

What distinguishes an **STM publication**? It is always written by domain experts (accounted for by their statement of affiliation, i.e. their address information), follows a formal structure (e.g. IMRaD: Introduction, Methods, Results and Discussion; Stock & Stock, 2008, 392), contains an Abstract as well as a(n ideally complete) list of all preparatory work relevant for the publication, usually as a bibliography in standard format (such as APA, the citation format of the American Psychological Association) (Figure 9.3).

Science and technology in the region: The output of regional science and technology, its strengths and its leading institutions

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We operationalize scientific output in a region by means of the number of articles (as in the SciSearch database) per year and technology output by means of the number of patent applications (as in the database of the European Patent Office) per priority year. All informetric analyses were done using the DIALOG online-system. The main research questions are the following: Which scientific and technological fields or topics are most influent within a region and which institutions or companies are mainly publishing articles or holding patents? Do the distributions of regional science and technology fields and of publishing institutions follow the well-known informetric function? Are there – as it is expected – only few fields and few institutions which dominate the region? Is there a connection between the economic power of a region and the regional publication and patent output? Examples studied in detail are seven German regions: Aachen, Düsseldorf, Hamburg, Köln (Cologne), Leipzig – Halle – Dessau, München (Munich), and Stuttgart. Three different indicators were used, science and technology attraction of a region (number of scientific articles and patents), science and technology intensity (articles and patents per 1,000 inhabitants), and science and technology density (articles and patents per 1 billion EURO gross value added). Top region concerning both attraction and intensity is Munich, concerning density it is Aachen.

References

Aksnes, D. W., Sivertsen, G. (2004), The effect of highly cited papers on national citation indicators, *Scientometrics*, 59 : 213–224.

Audretsch, D., Feldman, M. (1996), R&D spillovers and the geography of innovation and production, *American Economic Review*, 86 : 630–640.

Scientometrics 63 (2005) 527

Figure 9.3: Characteristics of STM Information on the Example of a Magazine Article: Account of Expertise, Abstract, References. Source: Scientometrics.

Within the large area of STM, there are heavily compartmentalized submarkets, which lead to **knowledge gaps**. It can be observed for several scientific disciplines that scientists who work in companies or other non-academic institutions are isolated from academics–and vice versa. Certain magazines thus preferentially address scientific practitioners, whereas others prefer academics as their target group. There is hardly any information exchange between the two groups (Schlögl & Stock, 2008, 661, for the area of Library and Information Science, LIS):

> There is only a low level of information exchange between practitioners and academics. Each of the two groups uses mainly its particular communication channels, i.e. practitioners (as authors) write primarily for practitioners, academics (as authors) write mainly for academics. As a consequence, there is a gap between the communities of LIS academics and LIS practitioners.

Practitioners–not only in LIS but also in other disciplines, e.g. medicine–do not make adequate use (or none at all) of the respective current scientific results, while academics often abstract from problems set by "real life". The information stream between both parties is massively impaired, to the detriment of both (Figure 9.4). The criteria of scientific publications are pointed differently for practically oriented magazines than for academic ones: the number of references is higher for the latter, as is the number of members of the editorial board, whereas magazines for practitioners often carry advertisements (Schlögl & Stock, 2008, 654).

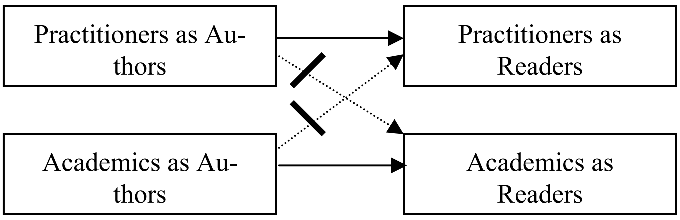


Figure 9.4: Scientists as Practitioners and as Academics.

Relief might be provided by the so-called **evidence-based** approach, in which one looks for the best possible evidence for the solution to any given problem. Evidence-based medicine is the most famous example, but there is also evidence-based library and information practice (Booth & Price, ed. 2004), evidence-based management and evidence-based knowledge management (Gust von Loh, 2009, Ch. 3). Gust von Loh (2009, 2) emphasizes:

> The principle of evidence-based information practice is the closing of gaps between theory and practice via the best possible evidence.

Apart from the gaps between academics and practitioners, there exist further obstacles in the flow of STM information. Disciplinary and language barriers impede the ideal information supply. Within LIS, for instance, German-language contributions are practically ignored entirely by the Anglo-American community, but even in the opposite direction, English-language articles are only seldomly cited by German library and information scientists (Schlögl & Stock, 2004). The cross-discipline transmission of STM information fails due to the individual disciplines' different foci, and due to the respective differences in terms' meanings. In this complex of problems, relief may be provided by so-called **Informing Science**, as Cohen (2009, 1) pictures it:

> The transdiscipline of Informing Science … explores how best to inform clients using information technology. … The essence of the Informing Science philosophy is the transfer of knowledge from one field to another: breaking down disciplinary boundaries that hinder the flow of information.

Both evidence-based approaches and Information Science name existing problems of STM information, but they have yet to prove their practical applicability.

9.2 The Production Process of STM Information

We will now describe the process of producing a magazine and conference contribution, respectively (Ware & Mabe, 2009). Both procedures run in similar ways and always involve–at least for academic magazines and conferences–a Peer Review (Figure 9.5). After completing the manuscript, the author (or, for teams, the Corresponding Author) sends it to the journal that is most relevant for the topic in question and promises the best publicity for the research results. Conferences (and, within, specific sessions) are selected according to the same criteria (here the touristic attractiveness of the conference location might also play a role). After the evaluation of formal and fundamental content criteria (e.g. whether the contribution fits the organ's thematic profile), three assessment variants are possible:

- assessment by committees of the magazine,
- blind Peer Review,
- double-blind Peer Review.

In the first case, the editor himself, or members of the editorial board, decide the article's acceptability; consequently, there will be no real Peer Review. Blind Peer Review means that the author is not told the names of his assessors. Double-blind Peer Review strives toward keeping secret the authors' identities from their assessors; this is hardly possible in practice, as any assessor who knows his way around a subject area (which, after all, he should do) would probably be able to guess the authors merely by looking at the references in the contribution. For LIS magazines, 26% of decisions are made by magazines' committees, 36% prefer blind Peer Review and 33% apply double-blind Peer Review (5% did not provide any information on the assessment method used) (Schlögl & Petschnig, 2005, 13).

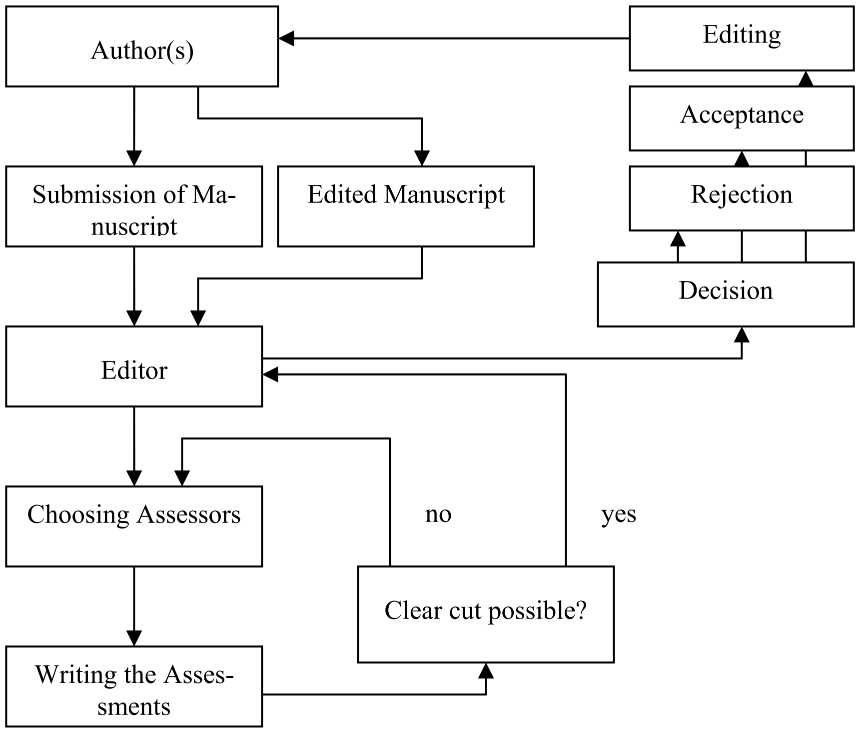


Figure 9.5: Schematic Representation of a Peer Review Procedure.

If external assessors are brought in, there will be generally two of them. If they do not agree, a third peer will be consulted. Some publishing organs also work with three assessors from the start. In cases where the assessors' evaluations differ radically, some magazines will consult a "top advisor". On the basis of the evaluations, the editor decides whether to reject, edit or directly accept a contribution. Depending on the prominence of a magazine or conference, there may be rejection quotas of more than 90%. If a redraft is required, the authors will be returned their annotated manuscript. The new drafts will then run through the assessment process once more. Bornmann and Daniel (2010) report, on the example of *Angewandte Chemie–Internation Edition*, that up to seven steps were necessary until a decision could be made, but that two steps were enough for 50% and three for another 30% of articles. The editors pursue a “clear-cut rule” (Bornmann & Daniel, 2010, 11):

> If the … editors decide on a manuscript using only initial external review, they generally follow a so-called clear-cut rule: Only those manuscripts are accepted for publication that were positively assessed by the reviewers (in most cases, two) with regard to the importance of the results and the suitability of publication of the manuscript.

The assessors assume the role of “gatekeepers” in this (pro bono) task. The editors of magazines from the large scientific publishers here primarily rely on scientists from the United States (for Elsevier magazines, for instance, 49.5% of all Peers are from the U.S.A., 11.9% from the U.K. and 6.4% from Germany) (Braun & Dióspatonyi, 2005, 115). The Peer Review procedure is not uncontroversial. It can be protracted, and the consistency of different assessors’ votes on the same script is not always very high; also, subjective influences on the side of the peers and of the editors cannot always be excluded (Bornmann, 2010)–but: there is no better alternative in the STM production process.

After a contribution has been accepted, time passes before the article is published. In the area of LIS, this will be six months for many magazines, while in extreme cases, idle periods of up to 21 months have been reported (Schlögl & Petschnig, 2005, 15). Before the print magazine is published, its digital version is generally released (from several weeks up to a few months) beforehand, initially without pagination, which is entered up for the print version’s distribution. For conferences, accepted contributions are published in the proceedings, which are available at the beginning of the sessions (mostly only in digital form, though).

If a manuscript is rejected by a magazine, the team of authors will, in all probability, submit it to another journal for publication, and the procedure will begin anew. In this case, several years may pass between the moment the research results are first specified and the article’s date of publication.

9.3 Digital and Print Products

The stream of STM information in the pre-internet era was informal (on a few conferences and personal meetings) as well as formal, via print media (full texts and bibliographies) (Vickery, 1999, 480). With the advent of the internet, the number of informal channels (such as blogs or message boards) broadened–central, however, is the location- and time-independent access to all formal STM publications (Vickery, 1999, 514). For this, two things must be ensured:

- all STM information are available in digital form,
- all scientists have access to this information from their workplace.

Ng (2009, 230) sketches the world of digital STM information:

> Traditional print journals have passed their golden age despite failing to achieve the Utopian ideals that the scientific publishing world envisioned, viz:
>
> Online availability of the entire full-text refereed research corpus.
>
> Availability on every researcher's desktop, everywhere, 24 hours a day.
>
> Interlinking of all papers and citations.
>
> Fully searchable, navigable, retrievable, impact-rankable research papers.
>
> Access to research data.
>
> For free, for all, forever.

Disregarding the last point, all of these ideals are realizable today–and have been realized, for the most part.

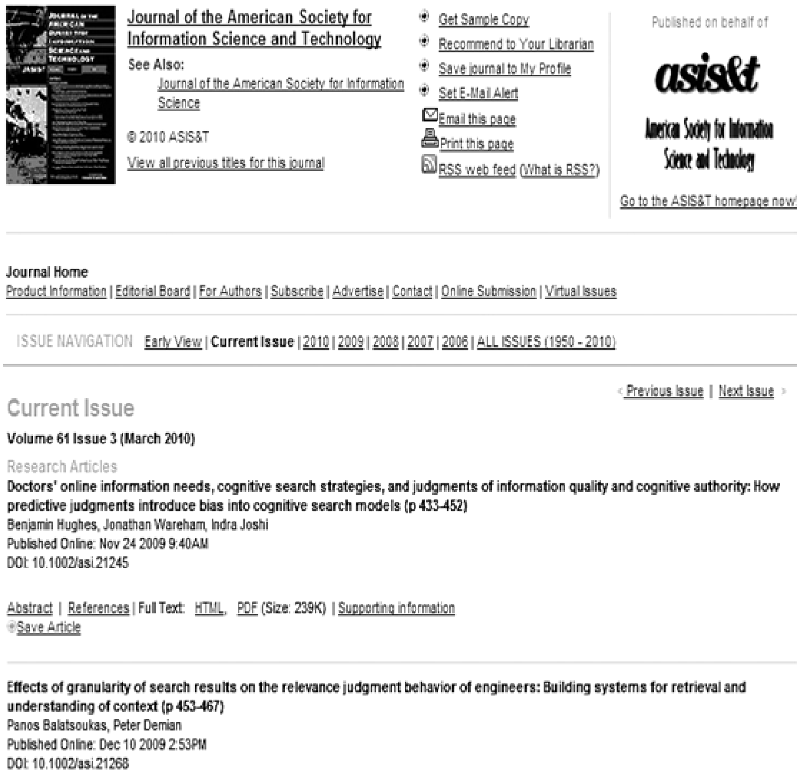
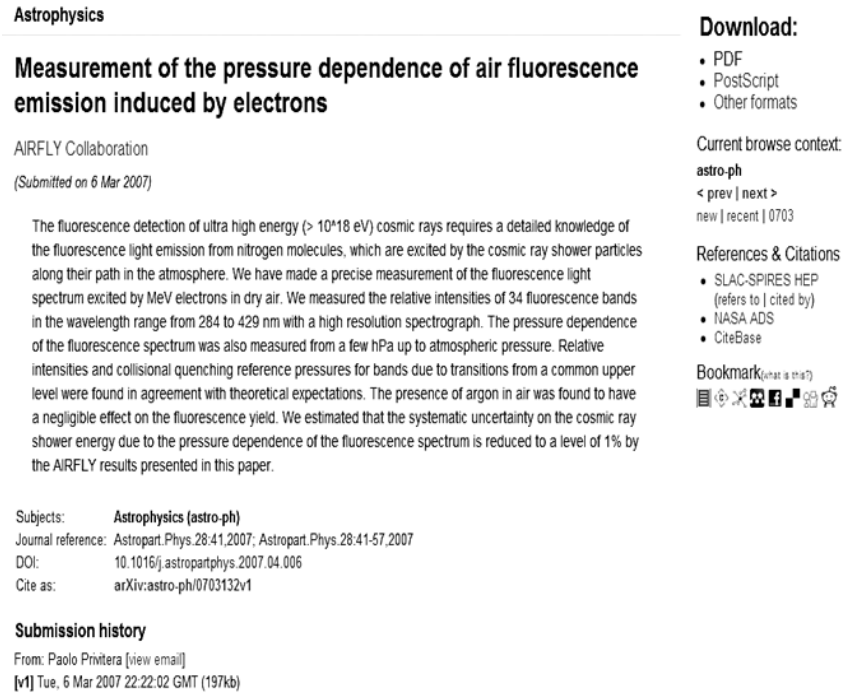


Figure 9.6: Table of Contents of the Digital Version of a Magazine. Source: Wiley InterScience.

The large **scientific publishers**, such as Elsevier or Springer, continuously pursue the product policy of offering digital versions alongside the established print products of their STM magazines. Their stock has been largely retrodigitalized, i.e. all articles, starting from issue N° 1 of a periodical, are available in the PDF format (for a full-text example, see Figure 9.3; the table of contents of a magazine is reproduced in Figure 9.6). Older contributions that have been scanned and are only stored graphically here are not full-text-searchable, so that OCR (Optical Character Recognition) procedures are used additionally. For more recent years, whose digital versions have been produced directly within the production process ("digital born papers"), full-text search is of course available throughout. The same goes for the proceedings of conferences in the STM area.


Astrophysics

Measurement of the pressure dependence of air fluorescence emission induced by electrons

AIRFLY Collaboration

(Submitted on 6 Mar 2007)

The fluorescence detection of ultra high energy (> 10^18 eV) cosmic rays requires a detailed knowledge of the fluorescence light emission from nitrogen molecules, which are excited by the cosmic ray shower particles along their path in the atmosphere. We have made a precise measurement of the fluorescence light spectrum excited by MeV electrons in dry air. We measured the relative intensities of 34 fluorescence bands in the wavelength range from 284 to 429 nm with a high resolution spectrograph. The pressure dependence of the fluorescence spectrum was also measured from a few hPa up to atmospheric pressure. Relative intensities and collisional quenching reference pressures for bands due to transitions from a common upper level were found in agreement with theoretical expectations. The presence of argon in air was found to have a negligible effect on the fluorescence yield. We estimated that the systematic uncertainty on the cosmic ray shower energy due to the pressure dependence of the fluorescence spectrum is reduced to a level of 1% by the AIRFLY results presented in this paper.

Subjects: Astrophysics (astro-ph)
Journal reference: Astropart.Phys.28:41,2007; Astropart.Phys.28:41-57,2007
DOI: 10.1016/j.astropartphys.2007.04.006
Cite as: arXiv:astro-ph/0703132v1

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Figure 9.7: Evidence of an Article on arXiv. Source: arXiv.

The production process from finished manuscript to published article takes a (sometimes very) long time. An additional way besides formal publication in a magazine or conference proceedings has been found in **Preprint archives**. A significant example is arXiv (Ginsparg, 2007; Haque & Ginsparg, 2009), focusing on physics, mathematics and IT, which is operated by the department of information science at Cornell University. Authors upload their script directly after finishing it, in order to effectively provide advance information about their research results. The scientific communication process can begin now–and not just months or years later. Thus, the article in Figure 9.7 had already been uploaded to arXiv in March 2007, even though the paper only appeared formally, in a specialist magazine, in September 2007. arXiv offers free access to the preprint (via "Download", top right) as well as to the published article (via the Digital Object Identifier, DOI, and the publisher's portal; bottom left, next to DOI).

Preprint archives are very popular in certain scientific disciplines–such as physics–but hardly play any role at all in other areas (chemistry for example) (Velden & Lagoze, 2009). Articles in arXiv may receive more citations that contributions that do not appear in preprint archives (for methodological reasons–there is a lack of comparative figures–such statements are not very reliable), and download figures on the scientific publishers' portals decrease (Davis & Fromerth, 2007). The user of preprint archives faces the task of scrutinizing contributions that have not been published formally (i.e. in a magazine / in proceedings with Peer Review), as these have not (or not yet) successfully cleared the hurdle of "quality assurance". Zhao (2005, 1414) emphasizes:

> Web-publishing is not as well controlled as journal publishing…

However, a lack of control cannot fundamentally be taken as a signal for lack of quality.

The process of continuous digitalization of publications in the humanities and social sciences is not as advanced as it is in natural sciences and medicine. This is not merely due to scholars' (at least sporadic) preferences for paper, but to financial restrictions on the (often very small and technically under-equipped) publishers. The Knight Higher Education Collaborative (2002, 215) demands either the parallel marketing of magazines and conference contributions in print and online for these sciences, too–or, for budgetary reasons, the establishment of e-only versions to replace the original print products.

Publisher-independent digital archives provide relief for all those periodicals whose publishers cannot, or do not want to, create digital versions of their magazines under their own steam. A successful example for such an archive is JSTOR (Journal Storage) (Garlock, Landis & Piontek, 1997; Guthrie, 1997; Spinella, 2008). JSTOR stores periodicals from N° 1 up to the respective current edition. The limitation for inclusion is reached with the expiration of an embargo period (of several months or a few years). In this time, the magazine's publisher holds the exclusive rights over their articles, so as not to endanger subscriptions. Spinella (2008, 80) formulates the goals of JSTOR:

> The initial mandate was to develop a trusted archive of the complete runs of scholarly journals, and to expand online access to those works as broadly as possible.

JSTOR scans the articles. Images are required for the display, the text, gleaned via OCT, is available for full-text search (Guthrie, 1997). JSTOR is a non-commercial project that seeks an advantage for all involved: scientists are provided online access to materials (which are often hard to get otherwise), librarians save storage space for the print versions and publishers are offered the possibility of digitally marketing their products. Since JSTOR started cooperating with Google, searches for articles are conducted primarily via this search engines as Spinella (2008, 81) reports:

> Researchers do discover JSTOR through many different channels, but we cannot overstate the impact of being indexed by Google.

Password-protected access to the articles' full texts (PDFs) is granted via JSTOR's portal.

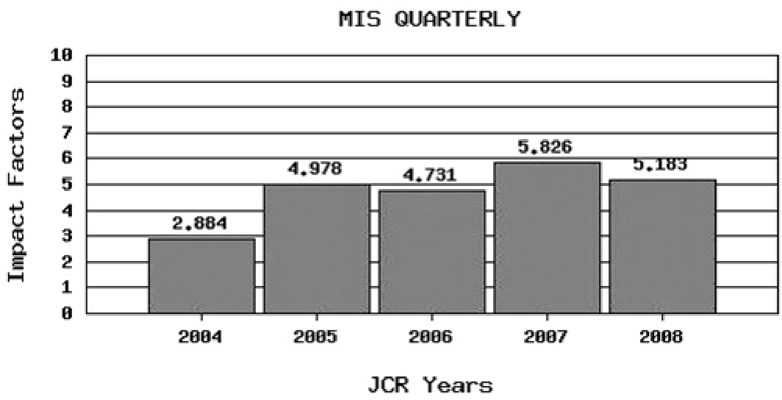


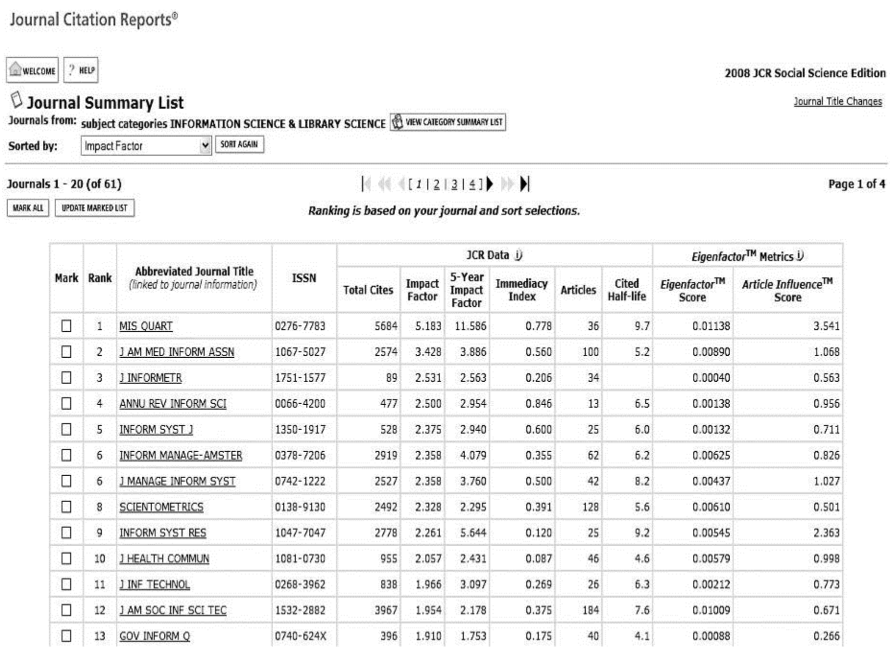
Figure 9.8: Time Series of the Impact Factor for the Magazine MIS Quarterly. Source: Journal Citation Reports.

9.4 Journal Impact Factor

One characteristic value has established itself for the evaluation of the importance of academic magazines: the Journal Impact Factor, formulated as early as 1963 by Garfield and Sher (Garfield & Sher, 1963, 200) and finalized in its current edition by Eugene Garfield in 1972. The Impact Factor is an indicator of central importance for journal scientometrics (Juchem, Schlögl & Stock, 2006). It takes into consideration both the number of publications in a magazine as well as the number of these publications' citations. The Impact Factor IF of a magazine M is calculated as a fractional number. The numerator is the number of citations for exactly one year t, which name articles from magazine M from the two preceding years (i.e. t–1 and t–2). The denominator is the number of source articles in M for the years t–1 and t–2. Let the number of source articles from M for t–1 be S(1), the number for t–2 be S(2), and the number of citations of all articles from M for the years t–1 and t–2 in the year t be C. The Impact Factor for M in t will be:

$$IF(M,t) = C / [S(1) + S(2)].$$

The values of the Impact Factor are published in Journal Citation Reports as part of "Web of Knowledge" by Thomson Reuters (Stock, 2001). There may be several variants of Journal Impact Factors by now, such as the Eigenfactor Score (reminiscent of Google's PageRank) (Stock, 2009), but Garfield's classical Impact Factor has lost nothing in significance. Figure 9.8 shows the progress of an academic magazine's Impact Factor; one can observe a steep increase of *MIS Quarterly*'s significance between the years 2004 and 2007. Figure 9.9 is a ranking of all magazines in the class "Information Science and Library Science" listed in Journal Citation Reports, structured according to their Impact Factor values for the year 2008.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Journals from: subject categories INFORMATION SCIENCE & LIBRARY SCIENCE | VIEW CATEGORY SUMMARY LIST

Sorted by: Impact Factor | SORT AGAIN

Journals 1 - 20 (of 61) [1 | 2 | 3 | 4] **Page 1 of 4**

MARK ALL | UPDATE MARKED LIST

Ranking is based on your journal and sort selections.

Mark	Rank	Abbreviated Journal Title (*linked to journal information*)	ISSN	JCR Data						Eigenfactor™ Metrics	
				Total Cites	Impact Factor	5-Year Impact Factor	Immediacy Index	Articles	Cited Half-life	Eigenfactor™ Score	Article Influence™ Score
☐	1	MIS QUART	0276-7783	5684	5.183	11.586	0.778	36	9.7	0.01138	3.541
☐	2	J AM MED INFORM ASSN	1067-5027	2574	3.428	3.886	0.560	100	5.2	0.00890	1.068
☐	3	J INFORMETR	1751-1577	89	2.531	2.563	0.206	34		0.00040	0.563
☐	4	ANNU REV INFORM SCI	0066-4200	477	2.500	2.954	0.846	13	6.5	0.00138	0.956
☐	5	INFORM SYST J	1350-1917	528	2.375	2.940	0.600	25	6.0	0.00132	0.711
☐	6	INFORM MANAGE-AMSTER	0378-7206	2919	2.358	4.079	0.355	62	6.2	0.00625	0.826
☐	6	J MANAGE INFORM SYST	0742-1222	2527	2.358	3.760	0.500	42	8.2	0.00437	1.027
☐	8	SCIENTOMETRICS	0138-9130	2492	2.328	2.295	0.391	128	5.6	0.00610	0.501
☐	9	INFORM SYST RES	1047-7047	2778	2.261	5.644	0.120	25	9.2	0.00545	2.363
☐	10	J HEALTH COMMUN	1081-0730	955	2.057	2.431	0.087	46	4.6	0.00579	0.998
☐	11	J INF TECHNOL	0268-3962	838	1.966	3.097	0.269	26	6.3	0.00212	0.773
☐	12	J AM SOC INF SCI TEC	1532-2882	3967	1.954	2.178	0.375	184	7.6	0.01009	0.671
☐	13	GOV INFORM Q	0740-624X	396	1.910	1.753	0.175	40	4.1	0.00088	0.266

Figure 9.9: Magazines of the Class "Information Science & Library Science", Arranged According to Impact Factor. Source: Journal Citation Reports.

The Impact Factor helps libraries in developing their stock, gives scientific publishers pointers to the location of their magazines, provides authors (as far as they do not already know "their" magazines) with publishing options and even plays a role (although methodologically highly dubious) (Stock, 2001) in the evaluation of institutions' and authors' research performances. As the citation habits of scientists from different disciplines can differ greatly, it is methodologically inadmissible to compare the IF values of periodicals across disciplines without any further normalization. Thus for example, the top medical magazine, the *New England Journal of Medicine*, has an Impact Factor of 44.0 for the year 2005 (Brown, 2007), whereas top information science journals, such as the *Journal of Documentation* or the *Journal of the American Society for Information Science and Technology* can only boast values of 1.52 and 1.29 (average values for the years 1997 through 2000) (Schlögl & Stock, 2008).

It cannot be concealed that the Impact Factor, too, has methodological problems (Stock, 2001). For certain disciplines (such as history), the time window (year of publication and the two preceding years) is far too short, the denominator of the IF formula restricts itself to "citable sources" (thus ignoring "letters to the editor", for instance), whereas the numerator includes citations of all contributions (including the letters). Also, neither the country-specific nor the discipline-specific representativeness is always very balanced. Some countries (including the U.S.A. and several EU states) are represented disproportionately highly, some others (e.g. China) are underrepresented. Certain disciplines (e.g. chemistry) are sufficiently represented, others (many areas of humanities and the social sciences) are not. A statistical problem must be taken into consideration. The IF is an arithmetic mean, which may only be calculated if the values approximately follow a Gaussian bell curve. The distribution of journal articles, though, is extremely lopsided to the left: a few articles are cited highly, whereas many are cited little or not at all. We can thus regard the IF exclusively as an estimated value for a magazine as a whole; any conclusion drawn for single articles is principally inadmissible. The separation into classes in Web of Knowledge can be slightly arbitrary. The two topmost magazines in Figure 9.9 hardly belong to the area of information and library science; *MIS Quarterly* is better described as a business informatics magazine, and the *Journal of the American Medical Information Association* represents medical informatics. To interpret the IF, the user is thus always required to possess expert knowledge in order to avoid misinterpretations.

9.5 STM eBooks

Digital books–eBooks–are electronic versions of books, to be consumed either on a normal computer (PC, laptop) or a specific device, such as Amazon's Kindle, which is very popular in the United States (Bedord, 2009). A further international prevalence of eBooks in the entertainment area is currently impeded by the different types of reading device as well as different and not always compatible formats (such as Amazon's AZW format for Kindle).

In contrast to the market for eBooks of fiction, some broadly accepted formats have already established themselves in the STM area. All important scientific publishers offer their books–mostly chapter-by-chapter–either in the PDF format, ePub (based on XML) or directly in the XML format (Göbel, 2010). The production and distribution of chapters from eBooks proceed analogously to the publication process of magazine articles. Publishers generally offer their digital products, i.e. magazine articles as well as eBooks, via a single interface (as, for example, the publisher de Gruyter does with its digital Portal Reference Global; see Figure 9.10).

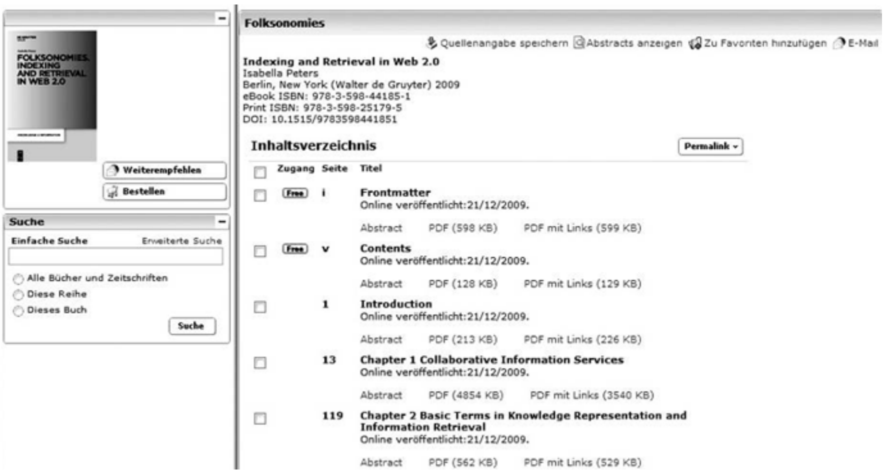


Figure 9.10: Chapter-by-Chapter Sales of an eBook. Source: De Gruyter Reference Global.

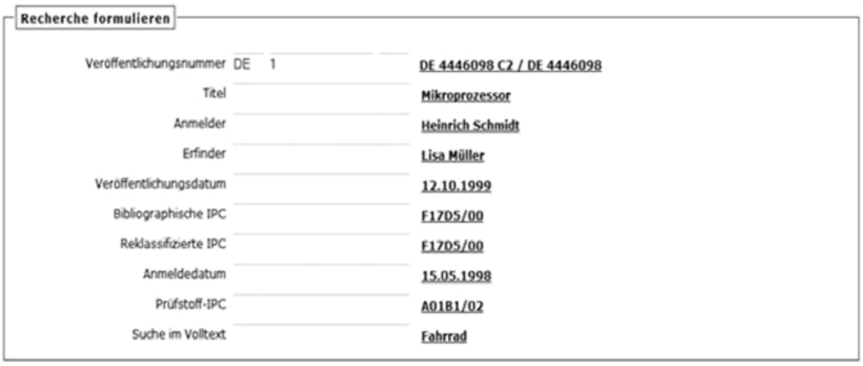
In the case of eChapters, it is important for authors and publishers that these represent a(n at least somewhat) coherent product, which can stand on its own. One mistake that can be observed from time to time is the omission to add a bibliography to the chapters. Hence, the book you are reading right now is suitable for eBook publication, as the bibliographies are printed chapter by chapter, leaving the individual chapters able to stand on their own.

Textbooks, too, are available as eBooks in the area of STM. Here it is shown that the students mainly use the digital versions to search for small sections of a book or specific facts. They are not read as a whole in this way; for this purpose, the students still buy (in some cases even more than before) the printed version (Nicholas, Rowlands & Jamali, 2010).

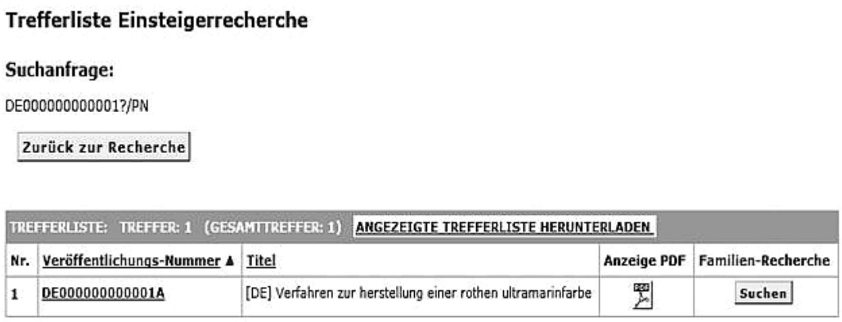
9.6 Patents and Utility Models

As concerns protective rights documents, we are lucky to have the patent and trademark offices of all major countries offer the totality of their documents for free usage, generally in the PDF format. Apart from the non-technical protective rights documents (brands and designs), all technical documents, patents as well as utility models, are thus available digitally (see above, Ch. 5). Figure 9.11 shows, on the example of the database of the German Patent and Trademark Office (DPMA; “Deutsches Patent- und Markenamt”), the process of research for a patent (sought here: the first German patent). The research (formulated in a search mask as represented in the graphics below, or in the search syntax) leads to a hit list, from which the suitable documents and the bibliographical data are selected.

Step 1: Search for Patents



Step 2: Display of Hit List



Step 3: Release of Patent Document (PDF)

KAISERLICHES PATENTAMT

PATENTSCHRIFT

№ 1.

JOH. ZELTNER

IN FIRMA: NURNBERGER ULTRAMÁRIN-FABRIK.

VERFAHREN ZUR HERSTELLUNG EINER ROTHEN ULTRAMARINFARBE.

Figure 9.11: Research for Patents and Utility Models. Source: Deutsches Patent- und Markenamt / DEPATISnet.

Finally, one arrives at a facsimile of the requested documents. The DPMA database provides comprehensive search options–e.g. via the notations of the International Patent Classification (IPC) (Stock & Stock, 2008, 215)–as well as the joining of members of a patent family.

9.7 Digital Object Identifiers (DOI)

Scientists cite different literature, which has been used in the preparation and execution of their research activities. It is of fundamental importance for the user to be able to navigate directly to the full text of the cited work from an article's references. This requires a unique label for each and every STM object. One such function is filled by the **Digital Object Identifiers** (DOI) (Mader, 2001), which are managed by the International DOI Foundation. Thus for instance, the above article in Figure 9.6 is uniquely labeled via the number *10.1002/asi21245*. The DOI always stays the same, even if a magazine changes publishers or moves to a different URL. The arguments before the slanted mark are the prefix and contain information about the registration agency (currently always *10*) and a combination of digits that describes an applicant (it is irrelevant whether this is a publisher, an imprint or a single magazine). The suffix behind the slanted mark is a freely definable combination of digits, which uniquely describes the object. Objects are not only text documents, but can be everything that is uniquely identifiable. Saved and publicly accessible research data thus also have DOIs. For the scientific arena, the company CrossRef processes the citation links between STM documents via DOIs and offers these to publishers as services rendered; there is a similar service, TIB DataCite (to which the Technical Information Library in Hanover has contributed decisively) for research data. The user merely clicks on the DOI (e.g. within a bibliography) and is thus led to his destination (Figure 9.12).

Sets & Subsets:

- Irino, T; Tada, R (2009): Chemical and mineral compositions of sediments from ODP Site 127-797. *Geological Institute, University of Tokyo*. [doi:10.1594/PANGAEA.726855]

Earthquake Event, Authored by Automated System:

- Geofon operator (2009): GEOFON event gfz2009kciu (NW Balkan Region) *GeoForschungsZentrum Potsdam(GFZ)*. [doi:10.1594/GFZ.GEOFON.gfz2009kciu]

Mapped Visualisation of a Dataset:

- Kraus, Stefan; del Valle, Rodolfo (2008): Geological map of Potter Peninsula (King George Island, South Shetland Islands, Antarctic Peninsula). *Instituto Antártico Chileno, Punta Arenas, Chile & Instituto Antártico Argentino, Buenos Aires, Argentina*. [doi:10.1594/PANGAEA.667386]

Video of eye operation that supplements a medical journal:

- B. Kirchhof (2009) Silicone oil bubbles entrapped in the vitreous base during silicone oil removal, *Video Journal of Vitreoretinal Surgery*. [doi: 10.3207/2959859860]

Figure 9.12: Navigation Between STM Objects. Above: Literature (via CrossRef), below: Research Data (via TIB DataCite). Source: International DOI Foundation.

9.8 Information Services with Bibliographic References to STM Publications

The totality of all STM publications comprises several hundred million documents–and counting. In practical work, it is impossible for scientists, engineers and physicians to get an overview or even to remember a temporarily valid status without consulting information services with bibliographic references. In, respectively before the acceptance of an STM project, it is thus absolutely required to consult relevant information services. We distinguish, roughly, between three different types of STM information services:

- general scientific information services,
- discipline-specific information services,
- publisher-specific information services.

Among the **general scientific databases**, there are three products that divide the market among themselves: Web of Science (WoS) by Thomson Reuters, Scopus by Elsevier and Scholar by Google (Bakkalbasi, Bauer & Wang, 2006; Falagas, Pitsouni, Malietzis & Pappas, 2008; Jacso, 2005), with the former two available for a fee in the Deep Web and the search engine Google Scholar available for free in the Surface Web. All three information services are citation databases, i.e. they work with citation indexing as a method of knowledge representation (Stock & Stock, 2008, Ch. 18). Web of Science and Scopus only consider contributions in academic journals and conference proceedings for their source documents, while Google Scholar locates documents that are available digitally and transport STM content (with a few blurry edges). Web of Science covers around 10,000 periodicals and contributions to roughly 110,000 conferences, Scopus processes around 16,500 evaluated journals, 350 book series as well as conference literature (as of spring 2010). There are broad overlaps in the sources, but all three information services must be used in practical application, as only in this way can a satisfactory literature base be realized. The great difference between Google Scholar and the two other products lies in their coverage of sources (disregarding any accidents and mistakes during production, WoS and Scopus process the sources from cover to cover, whereas Google Scholar is dependent upon the digital availability of single articles on the Web) as well as in the extent of their functionality (which is very restricted in Google Scholar's case).

We will now explicate some of the professional, general scientific information services' functions. Researchable are source articles (via the terms in title and Abstract as well as keywords specified by the author) as well as articles that cite an author or a specific work. The hit list provides context-specific options for refining the search according to scientific domain, author, language, document type etc. Desired aspects are automatically linked via AND as additional search arguments, undesirable ones are excluded from further searches via NOT. Additionally, there is the function of structuring the results according to date of publication or amount of citations received. For the individual bibliographical data pools, the user has the options of navigating "forward" (to the articles doing the citing), "backward" (to the passages that are cited) and (in WoS) to "related" documents (via bibliographical coupling; Stock & Stock, 2008, 335-337). Various tools facilitate simple informetric analyses (Stock, 2007, Ch. 11), such as stating the h-index (Stock, 2007, 443-444) or (again in WoS) creating rankings and time series.

Discipline-specific information services are available–in varying quality–for all scientific disciplines. For the "big" sciences, it can be assumed that the respective databases will use the respective terminology (via a nomenclature, a classification system, a thesaurus or the combination of several methods) for search and retrieval and that the databases are (more or less) exhaustive. Examples for "big" discipline-specific information services are (with statements on provider and extent as of mid-2010 in brackets):

- Biology: BIOSIS (Thomson Reuters / 21m citations),
- Chemistry: CA (Chemical Abstracts Services / 29m),
- Engineering Science: Compendex (Elsevier / 10m),

- Agriculture: CABA (CAB International / 6m),
- Medicine: Medline (U.S. National Library of Medicine / 19m) and EMBASE (Elsevier / 14m),
- Economics: ECONIS (Deutsche Zentralbibliothek für Wirtschaftswissenschaften / 3m),
- Patents and Utility Models: Derwent World Patents Index (Thomson Reuters / 19m patent families),
- Physics: INSPEC (Institution of Engineering and Technology / 12m).

In Figure 9.13, we see a typical discipline-specific bibliographic citation, which we researched in the medical database Medline, hosted by Ovid. The central quality traits are indexing via technical terms (in this field MeSH, "Medical Subject Headings", via descriptors; Stock & Stock, 2008, 241-243) and the informative content of the Abstract.

Unique Identifier	19213266
Record Owner	From MEDLINE, a database of the U.S. National Library of Medicine.
Status	MEDLINE
Authors	Millstein CB.
Authors Full Name	Millstein, Charles B.
Institution	Tufts University School of Dental Medicine, MA, USA. jeanmill74@aol.com
Title	Technology transfer: Kuwait--a quarter-century of progress.
Source	Journal of the History of Dentistry. 56(3):140-4, 2008.
Abbreviated Source	J Hist Dent. 56(3):140-4, 2008.
NLM Journal Name	Journal of the history of dentistry
Publishing Model	Journal available in: Print Citation processed from: Print
NLM Journal Code	9609747, cj7, 9609747
Journal Subset	D, Q
Country of Publication	United States
MeSH Subject Headings	Developed Countries *Developing Countries History, 20th Century History, 21st Century Kuwait *Pediatric Dentistry / hi [History] *Preventive Dentistry / hi [History] *Technology Transfer United States
Personal Name as Subject	Hein J. DePaola P. Soparkar P. Al-Mutawa S. Al-Duwairi YS.
Abstract	The transfer of knowledge, skill, and technology from resource-rich countries to resource-constrained countries is a valuable tool in improving global health. During an important period in dental history, one individual made this type of transfer a reality. John W. Hein was director of the Forsyth Dental Center in Boston when he wrote a short article in 1986 defining technology transfer. For it to be successful, either within a first-world, developed country or in a third-world, developing country, he determined that certain proven procedures should be followed, maintained, and updated. This paper will outline the development of his strategy for technology transfer, as well as its successful application in Kuwait.
ISSN Print	1089-6287
ISSN Linking	1089-6287
Publication Type	Biography. Historical Article. Journal Article. Portraits.
Language	English

Figure 9.13: Discipline-Specific Bibliographic Citation. Source: Medline / Ovid.

Publisher databases of the big scientific publishers, such as SpringerLink or ScienceDirect (by Elsevier) offer their own bibliographical information services. Elaborate services (such as ScienceDirect in Figure 9.14) are hardly distinguishable from general scientific databases in terms of appearance (ScienceDirect, for instance, allows for reference searches and facilitates the context-specific restriction of retrieval results). Their advantage is the free offer (there is only a charge for full texts), their disadvantage the restriction to products from the publisher in question. Since most publishers offer STM documents across several disciplines, they are not able to offer their users access via the respective scientific domains' terminologies (as the discipline-specific services do).

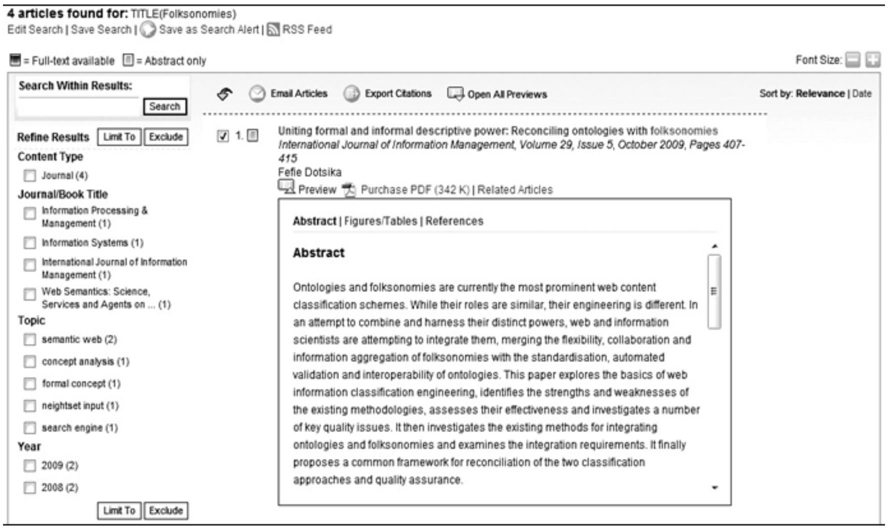


Figure 9.14: Bibliographical Record of a Publishing House Database. Source: ScienceDirect.

Bibliographic citations contain metadata on documents, but not the full texts themselves. What is required–if the user is not to be left sitting with the "hors d'œuvre"–is a link to a PDF of the full text. For publisher databases, this link is self-evident; for all other information services, it must be created. Generally, libraries run **link servers** (such as SFX; Van de Sompel & Beit-Arie, 2001) for their customers (scientists and students both) using DOIs, CrossRef or further proprietary services. If the customer finds a bibliographic citation in a general scientific or discipline-specific database, he is led–as far as the library has licensed the magazine or the book–directly to the full text; failing that, to the publisher database with its option of purchasing the document. A further service enters the fray: it must be checked whether the user (or the computer he is using) is authorized to access the desired source. Such tasks are performed by **authentification services** such as Shibboleth (Mikesell, 2004; Needleman, 2004).

9.9 STM Facts

For STM facts, we distinguish between two groups of information services. Fact databases record facts that are intellectually extracted from specialist literature, whereas information services with research data collect unpublished raw data that have been compiled in the context of research projects. In many areas of STM, users require both, literature and facts (Losoff, 2009).

```
Beilstein Records (BRN):        2498107
Beilstein Pref. RN (BPR):       127-91-3
CAS Reg. No. (RN):              127-91-3, 18172-67-3, 19902-08-0, 23089-32-9
Chemical Name (CN):             (1R)-pin-2(10)-ene, (+)-nopinene,
                                (+)-.beta.-pinene
Autonom Name (AUN):             6,6-dimethyl-2-methylene-
                                bicyclo<3.1.1>heptane
Molec. Formula (MF):            C10 H16
Molecular Weight (MW):          136.24
Lawson Number (LN):             4055
File Segment (FS):              Stereo compound
Compound Type (CTYPE):          isocyclic
Constitution ID (CONSID):       1226038
Tautomer ID (TAUTID):           2323395
Beilstein Citation (BSO):       3-05-00-00378, 4-05-00-00456, 5-05, 6-05
Entry Date (DED):               1989/07/05
Update Date (DUPD):             2001/07/25
```

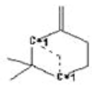


Figure 9.15: Document from a Fact Database (Extract). Source: Beilstein / STN International.

STM fact databases are diverse. We meet them in all the places where a purposeful search for single factual information can be conducted, e.g. for materials, gene sequences, inorganic and organic chemical structures and reactions (Stock, 2007, 503-505; Stock & Stock, 2008, 131-133). Our example in Figure 9.15 shows a small extract from a fact document on beta-pinene ($C_{10}H_{16}$), which lists the different designations of this material. Chemical characteristics and toxicity are also listed.

The global, Web-supported scientific cooperation–particularly for data-intensive endeavors (e.g. in high-energy physics, climate research or bioinformatics)–is called **e-science** (enhanced science) or (particularly in the United States) **cyberinfrastructure** (Hey & Trefethen, 2005; Newman, Ellisman & Orcutt, 2003). Large-scale scientific projects can thus be executed in different locations. Collections of **research data** came about, more as a side product of e-science, which are made available for further use by the scientists that originally collected the data. This involves the claim for the citability of such collections in publications derived from them (and that the data have been processed in such a way that even project outsiders can understand them). In Figure 9.16, we printed a research data pool (with the chart heavily abridged).

Citation:	White, J (2009): Stable Isotope Stacked Record of ice core GRIP913. doi:10.1594/PANGAEA.712617, *In Supplement to:* **White, James WC; Barlow, L K; Fisher, D; Grootes, Pieter Meiert; Jouzel, Jean; Johnsen, Sigfus J; Stuiver, Minze; Clausen, Henrik B (1997):** The climate signal in the stable isotopes of snow from Summit, Greenland: Results of comparisons with modern climate observations. *Journal of Geophysical Research*, **102(C12)**, 26425-26440, doi:10.1029/97JC00162
Reference(s):	**Steig, Eric J; Grootes, Pieter Meiert; Stuiver, Minze (1994):** Seasonal precipitation timing and ice core records. *Science*, **266 (5192)**, 1885-1886, doi:10.1126/science.266.5192.1885
	Stuiver, Minze; Grootes, Pieter Meiert; Braziunas, TF (1995): The GISP2 d18O Climate Record of the Past 16,500 Years and the Role of the Sun, Ocean, and Volcanoes. *Quaternary Research*, **44(3)**, 341-354, doi:10.1006/qres.1995.1079
	GRIP/GISP (1997): The Greenland Summit Ice Cores CD-ROM and new data archived since 1998. *National Snow and Ice Data Center, University of Colorado at Boulder, and World Data Center for Paleoclimatology, National Geophysical Data Center, Boulder Colorado*, http://www.ngdc.noaa.gov/paleo/icecore/greenland/greenland.html
Project(s):	**Greenland Ice Core Project/Greenland Ice Sheet Project** (GRIP/GISP)
Coverage:	*West:* -37.6422 * *East:* -37.6422 * *South:* 72.5872 * *North:* 72.5872
	Minimum Age: -0.029 ka BP * *Maximum Age:* 0.178 ka BP
Event(s):	**GRIP913** * *Latitude:* 72.5872 * *Longitude:* -37.6422 * *Date/Time:* 1991-06-01T00:00:00 * *Location:* Greenland * *Campaign:* GRIP * *Basis:* Sampling/drilling ice * *Device:* Drilling * *Comment:* core from the GRIP camp drilled in 1991
Comment:	Dating control as in White et al. (1997). GISP2 timescale is NOTidentical to official GISP2 timescale in the file gisp2age. Cal year1986=summer1985-summer1986
Parameter(s):	

#	Name	Short Name	Unit	Principal Investigator	Method	Comment
1	AGE	Age	ka BP			Geocode
2	Age	Age	year AD	White, James		
3	delta 18O, water	d18O H2O	per mil SMOW	White, James		

Size: 416 data points

1 Age [ka BP]	2 Age [year AD]	3 d18O H2O [per mil SMOW]
-0.029	1979	-36.43
-0.028	1978	-35.83
-0.027	1977	-33.35
-0.026	1976	-34.02
-0.025	1975	-36.74
-0.024	1974	-35.26
-0.023	1973	-36.21
-0.022	1972	-33.56
-0.021	1971	-32.43
-0.020	1970	-34.45
-0.019	1969	-33.96
-0.018	1968	-35.12
-0.017	1967	-35.37
-0.016	1966	-33.79
-0.015	1965	-34.10
-0.014	1964	-34.81
-0.013	1963	-35.88
-0.012	1962	-36.43
-0.011	1961	-35.82
-0.010	1960	-34.74
-0.009	1959	-34.12

Figure 9.16: Access to Research Data (Extract). Source: PANGAEA. Publishing Network for Geoscientific and Environmental Data.

9.10 The STM Market: Publishers, Libraries and Scientists

Users of STM information are, in most cases, scientists–in a university, a private or public research institution or a company. These users, though, generally do not appear on the information market as (buying) customers. This function is predominantly fulfilled by libraries, i.e. college libraries, specialist research libraries and company libraries. The libraries face the task of satisfying the information needs of "their" scientists as exhaustively as possible on a limited budget. This is not always possible. Academic journals and databases get more expensive by the year, and scientists keep requesting new periodicals to subscribe to. Moore-Jansen, Williams and Dadashzadeh (2001, 54) report of price increases for products of scientific publishers of 15% per year on average over the period from 1995 to 2000. The reasons for the price increases are the high production costs (e.g. for high-resolution images), increasing page numbers per year, the low circulation of some magazines and probably also certain publishers' high profit expectations.

If the libraries' acquisition budgets cannot keep up with the costs, this will invariably lead to a thinning of each respective institution's offer. This relation is called the **serials cancellation crisis** (Chrzastowski & Schmidt, 1997). The search for ways out of this unpleasant situation occasionally leads to innovative business models.

Publishers offer their digital versions of magazines and their eBooks in different variants:

- Subscription per journal title:
  - Subscription to print and digital version (price of the print subscription plus a small extra charge),
  - e-only (subscription to the digital version only),
- Subscription to a thematic bundle (or to the entire offer) of a publisher (digital),
- Pay-per-view.

General scientific and discipline-specific information services both offer libraries subscriptions, almost to the exclusion of any other offers. The costs for print versions are, for academic periodicals for use in libraries, between several hundred and several thousand Euros per year. The price for digital access varies depending on the number of employees or the number of scientific employees of an institution. For pay-per-view, the prices for an article vary between a few Euros to more than 30 Euros.

STM magazines and books are brought on the market either by profit-oriented **publishers** or by non-profit organizations, mostly **scientific societies** (Galyani-Moghaddam, 2006). Among the commercial publishers, a few big companies (e.g. Elsevier, Springer or Wiley-Blackwell) dominate the market. For the pricing of a periodical, its provenance–commercial publisher or scientific society–plays a remarkable role: on average, commercial publishers charge 2.8 times more than non-profit publishers (Galyani-Moghaddam, 2006, 115). But there are also exceptions. Thus the magazines of the American Physical Society (e.g. *Physical Review B*) are in the high-price segment, for instance.

For the electronic versions of periodicals and books, production and distribution costs are lowered (Varian, 1998), leading to an entirely new business model: the so-called **long tail business**. This is derived from the known curve distribution of an inverse power law, in which very few items (let us say magazines) are manifested very strongly (in the example: by number of readers) (Stock, 2007, 76-78). After a steep decline of the Y-values, the curve moves into the “long tail”. Here, there are very many items, which are manifested weakly, respectively. But even the low manifestations add up to considerable amounts–the long tail is, indeed, very long. “The future of business is selling less of more”, Chris Anderson claims (2004, 2006). Thomas H.P. Gould (2009) applies this idea to academic publishing. The market–according to Gould–can handle a lot more (cheap, i.e. digitally produced) magazines. Such magazines are profitable for a publisher, providing it publishes a sufficient amount of titles, even with very low subscription figures.

In purely digital solutions, the libraries are no longer “in possession” of “their” stock, as they merely license access to it. **Digital licenses** have the disadvantage of coming with the insecurity about the guarantee of long-term access to the titles. However, it is deemed an advantage that hundreds of meters of shelf space are saved, which would normally be filled with magazines and books.

In order to strengthen their negotiating power, libraries join up and form **consortiums**, negotiating with publishers as a unit. Any hoped-for savings are hardly realizable, but the results are a significantly larger offer for a relatively low surcharge (Filipek, 2009, 145). Another option of licensing STM literature for large user circles is represented by **national licenses** (Filipek, 2009, 76 et seq.). Two models can be distinguished: in the Icelandic model, the entire population, independently of their location (thus including home PCs) is provided with access to the licensed literature. The competing model only provides for access from select institutions (e.g. universities), but nation-wide. A mixed form of both approaches is pursued in Singapore; free access to the digital resources is provided to the citizens of this city-state either on their own computer at home, the computers in all libraries or those in selected libraries (Chellapandi, Han, & Boon, 2010; Sharma, Lim, & Boon, 2009). Marketing is used to try to safeguard that all citizens are aware of these information services (Dresel & Kaur, 2010).

We distinguish three distribution channels between publishers and libraries:

- Libraries (or their consortium leaders, respectively) negotiate directly with publishers.
- Libraries outsource the management of their periodicals, leaving the tasks of subscribing, controlling access to magazines etc. to **agencies** (such as Swets; Prior, 1997). The agencies, for their part, work together with the publishers in order to be able to offer an ideal range of STM literature. Libraries manage all their subscriptions via a single interface.
- Libraries contract the services of **hosts**, which bundle the single databases under one interface and also (at least partially) offer full texts (see Chapter 10). The borders between agencies and hosts can be blurry, as agencies also offer hosting services.

A broad discussion is conducted, in the process of scientific publishing, around the subject of **open access** to STM documents (Ball, 2004; Mann, von Walter, Hess, & Wigand, 2009). We can observe different approaches to granting customers free access:

- the publisher, or the publishing institution, carries the costs itself and offers the documents online for free ("golden road"),
- instead of the user, the author (or, respectively, his library or a library consortium, thus saving subscription costs) pays for the publication, which can now be offered for free (used, for example, by the publishing group BioMedCentral) (let us call this the "silver road"),
- authors or their institutions archive their documents themselves, on their homepages, so that open access is created–with high distribution on the internet ("green road").

All three models presuppose a "normal" production process of STM literature, i.e. including Peer Review. The "green" road is controversial in terms of copyright, at least if the author puts the PDF of the published article online, unless his publisher agrees to the "green" by-document. But this procedure is often tolerated, as it creates publicity for the source. Articles with open access have more readers on average, and more citations, than "closed-off" documents (Harnad & Brody, 2004).

How can a publisher guarantee the financing of its open access publications? Crow (2009, 9) specifies the following ways:

- the authors pay a fee for every contribution,
- the authors pay for a specific contribution to an otherwise commercial magazine, allowing this article to appear with open access,

For financing the "golden" road:

- the publication is financed via advertising, which is, unusual, however, particularly for academic journals (Schlögl & Petschnig, 2005), and is thus not exhaustively implemented (Frantsvåg, 2010),
- there is a sponsor,
- the publisher utilizes cross-subsidization (e.g. using profits from successful commercial publications),
- non-cash benefits and personnel services by scientific institutions (the most frequent case): a scientist (or a team of scientists) commits a part of his working hours (sometimes also his free time) to the publication of an open access magazine.

The value chain of STM publications from publisher to user is roughly schematized in Figure 9.17. Not all steps must necessarily be taken. The library can consult a subcription agency, but does not have to; in open access (the "green" road), the user can forego the services of a library.

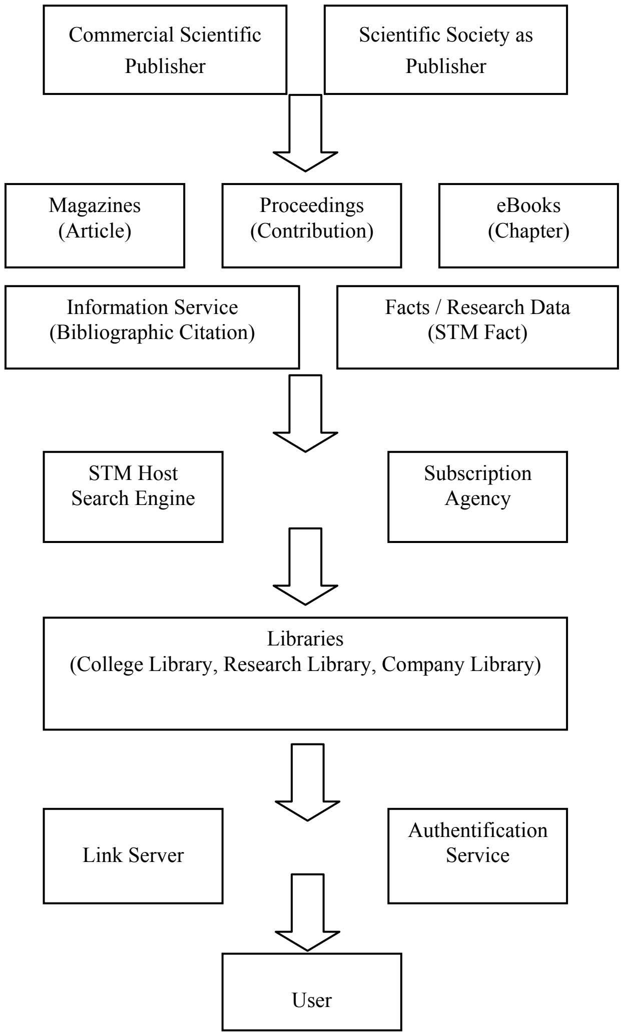


Figure 9.17: Value Chain Between Publisher and User for Digital STM Documents.

9.11 Conclusion

Only available in the printed version.

9.12 Bibliography

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