

The Citation Index as a Subject Index

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The *Science Citation Index*® (*SCI*®) was originally designed as a subject index, as a tool to circumvent many of the problems of using 'traditional' subject indexes.¹ So much, however, is being currently written about citation analysis in evaluation of research performance, in studying the history of science, in scientific planning, etc., that I'm afraid that primary use of the *SCI* as a *subject index* to the literature may be obscured by these admittedly important applications.

I should like to clear up any confusion about a citation index as a subject index. I suspect that many new users of the *SCI*—and perhaps some older users as well—do not think of a 'citation index' as a true 'subject index'. In this, they're wrong. A citation index is, I believe, the subject index *par excellence*. (Would you believe *non plus ultra*?) This does not mean that the *SCI* serves all requirements of every subject-index user. That is why the *SCI* includes a word index, the *Permuterm*® *Subject Index*.

The *SCI* happens simply not to use the conventions and format of the subject indexes with which most people are familiar. It expresses subject concepts not with 'subject headings' or descriptors or hierarchical codes, but with citations.

For example, *KNOWLES WS CHEM-TECH 2 590 1972* is not only a biblio-

graphical label, or tag, or (in computer lingo) a document *address*; it is also, in the *Science Citation Index*, a subject heading. Further, it is a *multiple* subject heading. For those who can't see this citation as a subject heading, I must translate it. It means, or stands for, or can be used to get at (among other things) literature on HYDROGENATION, ASYMMETRIC; alpha-AMINO ACIDS; PHOSPHINES; CATALYSTS; OLEFIN HYDROGENATION; LIGANDS, etc. Those are the subjects which Knowles and his colleagues discussed in the article published in 1972 in *Chemtech*.² When the Knowles article is subsequently cited by other articles, it will be cited because of some substantive 'subject' relationship between Knowles' work and later authors' research. That relationship is, after all, primarily why the Knowles article interested and aided those who cited it or will cite it.

As a subject heading, the citation is thus multiple and multi-faceted. By its very nature, citation indexing meets the requirements of the 'multiple subject heading' approach that most subject indexes of the conventional type insist upon as necessary. For the searcher who will be interested in later papers on asymmetric hydrogenation, the subject heading *KNOWLES WS CHEM-TECH 2 590 1972* will be just as

accessible and useful a subject heading as it will be for the searcher who will be interested in papers which cited it because Knowles discussed use of phosphine catalysts. It is important to note another fact, however. As a technique of multiple subject heading, citation indexing far surpasses any other, because as a subject heading the *potential* meaning of the citation is *unlimited*.

In constructing an index of the conventional type, the number of subject headings that can be assigned to a single item—journal article, book, thesis, no matter what the nature of the item—is limited. Conventional multiple subject heading is limited first by economic restrictions on the amount of intellectual labor that can be expended on input. It is limited further by economic restraints on the allowable size of the completed index, by just how big a book or how many volumes the publisher can afford to print and expect to sell. This is not true of citation indexing. As a subject heading the citation can represent any of the subject concepts that might not be indexed in the conventional subject index because of such economic or other considerations (discipline-orientation or 'slant', inadequate subject heading authority lists, etc.). Much more important, however, the citation will serve, as necessary, as a usable subject heading for such subject concepts as *future* research may reveal as newly significant in the Knowles article. The latent *potential* of the citation as a subject heading thus in itself accomplishes what neither the most prescient or wishful author nor the most omniscient or extravagant indexer can attempt.

Finally, as a subject heading technique, citation indexing gets around a

problem of indexing and of retrieval that I call the 'irrelevant specific.' The 'irrelevant specific' is ubiquitous in indexing, particularly in biomedical indexing, largely because it reflects an inescapable fact of research methodology. For example, an author publishes a paper entitled, "The effect of 1,2,3-trigrouppcompoundol on the nictitating membrane of the cat." In a conventional subject index, because of the influence titles do (and should) have on choice of subject headings, routine indexing will likely as not put entries (sometimes the only entries) for this article under some such headings as *COMPOUNDOL*, *derivatives* and *NICTITATING MEMBRANE*, *pharmacology*. In neither of these specifically is the author or any of his literature-searching colleagues particularly interested *per se*. What the author was studying and wants his colleagues to know about is the effect of *indole alkaloids* on *sympathetic nervous response*. The particular compound and the particular organ were the *tools* not the *objects* of the experimental work. It becomes increasingly necessary to be able to retrieve the article by subject *concept* rather than by experimental *specifics* as one moves away from the work in time within the specialty, and as one moves away from it in space, as it were, across specialties and disciplines. Any experienced reference librarian will confirm this necessity. It is at base a major reason for the construction of hierarchical classifications in some subject indexing schemes, and for the elaborate system of vertical and horizontal cross-referencing in others. A citation index, let it be noted, requires neither.

Use of the citation as a subject heading has one other extremely important

capability. It removes practical restrictions on the subject scope of the material being indexed. In my preference for, and recommendation of a citation index, I do not mean to put down subject indexes of the conventional type. Many scientific disciplines have superb indexes to their literatures, indexes that are truly monuments to the scholarship, ingenuity, and dedication of chemists, physicists, engineers, physicians. You are as well acquainted with these indexes as I am; we grew up with them. But recall this about them: they remain disciplinary or discipline-oriented indexes. Though research nowadays has become more and more multidisciplinary and interdisciplinary--particularly innovative applied research--these disciplinary indexes cannot extend themselves into truly multidisciplinary coverage without compounding the problems which make the conventional index difficult to use. As they attempt it, their coverage becomes more and more 'selective', exactly the thing that should not happen. Terminology becomes a nightmare. The economic requirements of the intellectual labor involved become prohibitive.

Economics aside, the characteristics of disciplinary indexes, the philosophy

and rationale of their production, seem to me intricately involved with the nature of the particular specialty--its 'language' and terminology, the level of its technology, its very *raison d'être* (scholarship or science, pure or applied, science or technology, academic or industrial, etc.). Any theoretical demonstrations to the contrary, such disciplinary indexes cannot be enlarged into truly multidisciplinary tools without abandoning the philosophies and policies, the *modus operandi* and the very intellectual labor that make them what they are. The fact remains, however, that today's multidisciplinary research and its innovative application require the rapid interdisciplinary transfer of information.³ It demands, therefore, among other things a truly multidisciplinary index that processes and makes available to any searcher the literature of agriculture and behavioral psychology as easily as it processes and makes available by the same methods the literature of economics and thermodynamics. The *Science Citation Index* is just such a multidisciplinary index, and I know of no other. Certainly I don't know of one that your secretary or newest assistant can be trained in an hour to use as easily and efficiently as a telephone book.⁴

1. As an historical note, it may be interesting that one of my earliest and least-known papers was: Garfield, E. Breaking the subject index barrier; a citation index for chemical patents. *Journal of the Patent Office Society* 39(8):583-95, 1957.--The paper had been presented earlier at the 128th National Meeting of the American Chemical Society, Division of Chemical Literature, Minneapolis, 16 September 1955. Its title and subject matter record the frustration in my use of traditional subject indexes that led to the implementation of the *SCI*.

2. Knowles, W.S. et al. Asymmetric hydrogenation yields alpha-amino acids. *Chemical Technology* 2:592, 1972.

3. Garfield, E. "A Unified Index to Science." In: *Proceedings of the International Conference on Scientific Information, Washington, D.C., November 16-21,*

1958. 2 vols. (Washington, D.C.: National Academy of Sciences/National Research Council, 1959), vol. 1, pp. 461-69.

4. There is an abundant literature on the structure and use of the *SCI*. The following papers can serve as an introduction, and reprints are available from the authors at ISI® , 325 Chestnut Street, Philadelphia, Pa. 19106, USA.

a. Garfield, E. *Science Citation Index*, a new dimension in indexing. *Science* 144: 649-54, 1964.

b. Malin, M.V. The *Science Citation Index*, a new concept in indexing. *Library Trends* 16(3):374-387, 1968.

c. Weinstock, M. "Citation Indexes." In: *Encyclopedia of Library and Information Science* (New York: Marcel Dekker, 1971) vol. 5, pp. 16-40.