

The Power of Citation Searching

IT MAY BE EFFECTIVE to find relevant literature by searching for articles by subject descriptors or keywords, but subject searching is not the only way. When authors of scholarly pieces cite relevant sources in the references or notes sections of their articles, researchers can thus extend their literature searches.

The power of citation searching lies in the capacity to take a seminal article and uncover who the author was influenced by (who was cited) and go forward in time to discover how that seminal research affected newer works (who is citing it). ISI (a Thomson business, formerly Institute for Scientific Information) has allowed such techniques to be used by serious searchers for years by providing the means of searching for known articles or authors in the "cited reference" field of ISI's citation indexes.

In 1997 the reach of citation searching increased dramatically when ISI introduced ISI Web of Science, now part of ISI Web of Knowledge. It reflects the interrelated "web" of scholarship whereby a user-friendly web interface made citation searching accessible to end users. Web of Science is already popular in university libraries, and ISI is hoping the additional functionality offered under ISI Web of Knowledge will build on that popularity by providing additional content sources and databases, plus cross-file searching, beginning in December 2001 (see www.isinet.com).

An old tool made new

Although the web seems a natural platform for citation searching, the concept is not new; citation searching has long been a mainstay of legal research.



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More than 40 years ago, Eugene Garfield began to develop the idea of a scientific information product that would use this new method of finding relevant articles. Instead of the subject searching common in most indexes, Garfield's citation indexes provided access to articles that had cited a relevant article and included citation lists in the bibliographic records for articles listed in the indexes. These lists were designated the "cited reference" field.

Software features can carry citation searching even further. For example, papers that cite the same articles may be related (even if they don't cite each other), or interdisciplinary relationships may be identified through common co-citing patterns. I can find articles that cite my own work, but I can also find who in turn is citing those articles (and on and on) and, in addition, what two or more relevant articles are cited in common by other authors.

Tracing impact

Anyone who works in academia is familiar with another common use: professors who want to measure the impact of their work want to know how many (and which) researchers are referring to their articles, knowledge of which may bear on promotion and tenure decisions.

Impact, as measured by number of cites, is also extended to journals. (ISI Journal Citation Reports show which journals receive the most citations on the average per article, and, rightly or wrongly, authors in some countries are paid bonuses for publishing in high-impact journals.) For academic disciplines, ISI Essential Science Indicators provides rankings of nations, individuals, or journals or universities themselves (universities are ranked according to the collective citations to their faculties).

ISI's Rodney Yancey, manager of corporate communications, also suggests that researchers use citation searching to "track the work of a research colleague or noted authority; verify the accuracy of cited references; identify the sources of information that

competitors worldwide are consulting for their research; and construct an objective history of a field of study, significant invention or discovery."

He further explains that citation indexing "exploits the formal linkages between papers established by the authors themselves. Citation searching offers the unique capability of finding new, unknown information, based on older, known information. Going forward in time, a user can take a seminal paper and discover what influenced that work and then trace that idea forward to see its impact."

Clearly, the idea of citation searching has proven a success, first in the awkward medium of print and later through standard online searching tools on systems like Dialog. But it was not until the web and ISI Web of Science that citation searching became a more powerful and widely accessible tool.

ISI Web of Science

Today, Web of Science provides a web interface to the ISI citation databases—Science Citation Index Expanded, Social Sciences Citation Index, and Arts & Humanities Citation Index. Over 8600 editorially selected peer-reviewed journals in all fields and published in many countries are indexed, with records including bibliographic data, system-assigned descriptors, author abstracts, and cited references. By the end of 2001, nearly half of the journal titles will include links to their full-text articles (about six million links to full-text and other scholarly content in all as of September 2001).

Academic research libraries represent the biggest customer base for Web of Science, but ISI's Yancey says government organizations, corporations, and special and public libraries also subscribe. Academic libraries report that the service is very popular with faculty and students, and, although it is very expensive per year compared with other services, it is used so much that the cost per use can be a relative bargain. That has been our experience at the University of Tennessee.

ONLINE DATABASES

When asked the advantages of searching the ISI citation databases on Web of Science vs. searching them on other systems, Yancey notes that some vendors offer more limited coverage, while Web of Science has back-year data to 1945. In addition, it offers subscription-based pricing and full-text links.

The interface for Web of Science is friendlier, and the system offers features that are geared specifically to citation searching. Unlike the ISI SciSearch Dialog file of the ISI citation indexes, which provides citation counts only for a first author in an article, Web of Science provides at least partial citation counts for second, third, and other co-authors. When the cited reference comes from one of the journals indexed by ISI, all authors are searchable. Relationships between authors and articles can get even more complex in Web of Science, with "co-citation" capabilities. Co-citation identifies articles that do not directly cite each other but that cite other documents in common. Articles that cite many other articles in common likely have a strong subject relationship.

All three of the citation indexes can be searched together, or users may select only one or two to search. Especially for interdisciplinary fields, it is a good idea to search Science Citation Index and Social Sciences Citation Index (at least) together.

Power searchers who use the citation indexes for bibliometric research will probably want to stick with the ISI SciSearch in Dialog, however. Web of Science limits the total number of citations that can be retrieved and does not include all of Dialog's power search capabilities. Features such as remove duplicates, successive searching by year without reentering a search, rank, and the capability of building huge sets that can be fully manipulated still make Dialog the power searcher's or bibliometrician's system of choice. ISI promises increased functionality and power to Web of Science beginning in December.

ISI Web of Knowledge

Much of this increased functionality is being built now with ISI's new search platform, called ISI Web of Knowledge. This is "not a product," the company says, but "a platform or portal that houses the Web of Science and other resources." ISI Web of Knowledge extends offerings beyond the cita-

tion indexes and ISI Current Contents Connect, which provide access to journal literature to include access to patents (Derwent Innovations Index), proceedings (ISI Proceedings), life sciences journals (BIOSIS Previews), a research evaluation tool (ISI Essential Science Indicators), and editorially selected and abstracted web resources (Current Contents eSearch). In addition, the system is compatible with reference management tools like EndNote, Reference Manager, and Procite.

User instruction classes should teach how to exploit this powerful capability

ISI Web of Knowledge already offers a new interface and more behind-the-scenes reliability, but its real power won't be available until the end of 2001 when version 1.0 is released. At that time, ISI will provide cross-search functionality across four databases—Web of Science, ISI Proceedings, Biosis Previews, and Derwent Innovations Index. ISI plans to increase and enhance this functionality across other ISI Web of Knowledge resources.

According to Yancey, "When the cross-search feature is rolled out, a user will be able to perform natural-language searches across these content resources, offering single-session management from a single URL." Other promised features will be the ability to combine subject and cited reference searching, personalization features that will allow users to create a customized interface, and expanded full-text linking.

Chemical and psychology citations

Although it is the oldest and most sophisticated citation service, ISI is no longer the only service offering citation searching. With full texts available online, many systems allow the "references," "bibliography," or "citation" field to be searched. Alternatively, they can build links from citations to cited papers. In addition, this summer the Chemical Abstracts Service (CAS) and American Psychological Association

(APA) both announced new cited reference products.

In 1999, CAS began adding citations to its CAPlus (Chemical Abstracts) database at the rate of almost 20 million per year. According to CAS Director Robert J. Massie, "This growing collection of citations is valuable in itself but even more so in terms of their links within the CAS databases."

Science Spotlight is a new product that uses the citation information to provide lists of the most highly cited documents in the CAS databases for the last two publication years and adds links from the bibliographic records to the electronic full texts. The service also lists the most often requested full-text articles in a quarter from the ChemPort Connection full-text service. Massie notes, "Science Spotlight is a first step in...deriving insights into the direction and focus of scientific research today." (For more information, see www.cas.org/spotlight.)

Cited references are also being included in the bibliographic records in the PsycINFO database, beginning with those added in 2000. Every item cited in each primary document will be listed in the bibliographic record. The citations will be linked either to a full-text article or to the relevant abstract. Linda Beebe, senior director of PsycINFO, says that "providing this ability to track research forward and backward in time is a service to the users, particularly academic researchers, but we also see cited references as an excellent service to other PsycINFO constituencies: the librarians who teach users to search and the publishers whose literature we help researchers find." The new cited reference feature will be available in March 2002.

A powerful strategy

The value of cited references has stood the test of time. New software features that exploit the relationships of cited articles, the power of web links, and the availability of online full texts make cited references more useful than ever.

The time has come for a powerful idea of nearly half a century ago. Following the links of cited references is a valuable search strategy that goes beyond keyword or descriptor searching for relevant articles on a topic. User instruction classes should teach how to exploit this powerful capability. Watch for other databases and systems to incorporate more citation searching.