

Citation Analysis

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Citations and reasons for citing

Citations are notes placed in the main text of an academic publication. Citations are calls to *bibliographic descriptions placed in the section of references. The principle underlying citation indexing is as follows: if one document cites another document, they bear a conceptual relationship. The references given in a publication link that publication to previous *knowledge. This is the basic idea that lead to Citation Indices, published by the Philadelphia based, *Institute for Scientific Information (<http://www.isinet.com>). In addition, *journal-to-journal citation *data are compiled by the ISI and published in the Journal of Citation Reports (JCR). Citation analysis are studies of citations to and from *documents, *authors of such *documents or *journals (if the *documents are journal articles).

The issue of why *authors cite other *authors has been widely discussed among scholars. The different functions of citations are:

- a) Giving credit (i.e.: identifying antecedents and original publications in which an idea, concept or principle was introduced, ...)
- b) Previous work (i.e.: identifying general *documents related with the research topic; presenting previous results or announcing future work; commenting, correcting or criticizing previous work; identifying methodology, equipment, etc.)
- c) Authority (i.e.: substantiating claims and persuading readers; authenticating *data and other results or identifying the results by others supporting the own's work)
- d) Social factors (i.e.: citing prestigious researchers, citing the work by graduate students, fellows and coworkers to increase their visibility; "perfunctory" citations).

Citation data obtained from ISI *databases reveal that citation distributions are very skewed: the majority of all references cite relatively few *journals and *authors.

Evaluation of research performance

Citation analysis has been used for the evaluation of research performance. Among others, the main uses have been the study of rankings of *journals, university departments, scientists, research institutions and academic *journals. The starting point of this approach is that citations, even the negative ones, are a measure of influence in science: the more often an article is cited the more it is known to the scientific community. The whole academic community acts as a big set of peers to recognize, by means of citations, the value of a given contribution and the decisions of this jury can be studied using Citation Indices.

Citation analysis can be used to identify the most frequently cited *journals relevant to a given field. As noted by many studies, in a given area or discipline, a few core *journals receive many citations and the rest of *journals receive far less citation. This pattern has been also identified

with *authors and other units of analysis.

When used to study research performance, all publications or a sample, covering a given time period, are selected. Typically, research papers published in primary sources (academic *journals) are used as units of analysis. Next, citations to these *documents are collected from Citation Indices to be analyzed to discover the most cited *authors or articles and the antecedents or core *documents in a given field or discipline.

The work done until now demonstrates that there is correlation between most-cited *authors and the judgement of peers on academic excellence, eminency and/or visibility. However, raw citation counts should be used with care for evaluating the quality of scientific work done by individual scientists. For example, is a scientist who has received 200 citations the half as qualified than another one receiving 400 citations?. Citation analysis cannot replace experts that read and evaluate the work done by other(s) within the same field and serve best when complement other evidences.

Structure of science

Dynamic mapping of science using Citation Indices has been pursued from more than 30 years now. The starting point is that citations from paper to paper or from *journal to *journal provide indicators of intellectual linkages between subjects areas, organizations or individuals. Research approaches used in this field study cocitations (one *document is cited by two other *documents) and bibliographic coupling (two *documents are cited in another *document).

The clustering of citation matrices has been pursued for the purpose of obtaining comprehensive and dynamic *maps of science in which the natural structural units of Science are shown.

Different analytic units and methodologies have been used. Thus, there are *networks of *authors, references, citations, institutions and *journals. Studies on different levels (i.e. word, article, *journal,...) and using different methodologies (cluster analysis, factorial analysis, graph

analysis, *neural networks, multidimensional scaling,...) are found in the *bibliography. And there are even *authors who have integrated multiple sources of *information in literature-based *maps of science to visualize semantic spaces and *networks. Among the various units of analysis listed above, *journals merit special attention from researchers.

The results of studies carried out with the above methodologies have been used to identify science and discipline *maps, research fronts, *networks of scientific *journals, epistemic and conceptual *networks, *invisible colleges or *author *networks.

Some problems and caveats

Potential limitations for citation analysis are:

1. Not all significant journals are covered by the ISI in the Citation Indices.
2. Some informal influences are not cited. On the other side, repetition of errors of detail reveals secondary or tertiary citing: some *documents are cited without having been read.
3. There are different kinds of citations (i.e.: positive citations, self-citations, negative citations, ...)
4. Citation indices include only printed journals, and, in some research fields, a significant part of publication is done in *electronic journal archives.
5. Important and influential discoveries are often incorporated by "obliteration" in the common knowledge of a given discipline, and the original paper reporting them could be not much cited.
6. Some errors can interfere (i.e.: errors may occur in the year, volume and/or page numbers of a citation; names can be misspelled; it can be inconsistent use of initials by *authors, homonyms can be confused, etc.)

Readings

Case, D.O. and Higgins, G.M. (2000) How can we investigate citation behavior? A study of reasons for citing literature in communication, *Journal of the American Society for Information Science*, Vol. 51, pp. 635-645.

Cronin, B. (1984) *The citation process*, London: Taylor Graham

Seglen, P.O. (1992). The skewness of science. *Journal of the American Society for Information Science*, Vol 43, pp. 628-638.

White, H.D. and McCain, K.W. (1998) Visualizing a discipline: An author co-citation analysis of information science, 1972-1995, *Journal of the American Society for Information Science*, Vol. 49, pp. 327-355.

See also many articles at the webpage of Prof. *Eugene Garfield (<http://garfield.library.upenn.edu>)