

9-1-2007

## Scientometrics from past to present

Research Trends Editorial Board

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### Recommended Citation

Research Trends Editorial Board (2007) "Scientometrics from past to present," *Research Trends*: Vol. 1 : Iss. 1 , Article 2.

Available at: <https://www.researchtrends.com/researchtrends/vol1/iss1/2>

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## The value of bibliometric measures



# Scientometrics from past to present

Scientometric research, the quantitative mathematical study of science and technology, encompassing both bibliometric and economic analysis (1), is expanding at an enormous pace. This is evidenced in increasing attendance rates at important industry conferences, and the recent launch of the dedicated *Journal of Informetrics*. Indeed, if one were to pick up an issue of any of the leading journals in the field today, one would find research covering article output, citation relationships between disciplines and geographical analysis linked to these. In a two-part article, we explore not only scientometrics' past but also its impact on and relevance in the present.

The origins of bibliometric research can be traced back to the beginning of the 19th century within areas such as law. Shapiro (1999) (2) indicates that many aspects of bibliometrics were "practiced in the legal field long before being introduced into scientific literature". Early research in the 1880s was reported by Delmas (1992), who describes documentation in France, but initial studies on qualitative and quantitative analysis of science seem to originate within psychological fields (Godin 2006) (3). Godin cites the work of Buchner in describing the notion of "scientific" psychology as "factual, inductive, measurable and experimental" and in 1920 Boring presented research on subject and geographical analysis of psychologists.

### Laying down the Law

Probably the earliest, most definable research within the scientometric field was the work that gave rise to the laws of bibliometrics. The first, which came to be known as Lotka's Law, after Alfred Lotka, can be traced back to 1926 and suggested that within a defined area over a specific period a low number of authors accounted for a large percentage of publications in the area. This was followed in 1935 by the work of George Kingsley Zipf, which describes the frequency of words in a text and became known as Zipf's Law. Zipf's research was refined into two main laws looking at high and low frequency words within a text. In 1948 Samuel Clement Bradford's analysis indicated that within a given area over a specific time a few journals publish a high percent of articles within the area and there are many journals that publish only a few articles each: Bradford's Law. These laws continue to be studied and form the basis of the development of the modern-day scientometric literature.

In 1944, Lehman described the relationship between quantity and quality within scientific writing and this was followed in 1952 by Dennis, who analyzed the effect of scientists' age on

these two elements. Again these types of analyses continue to be described in the current literature, and began to direct thinking towards averaged metrics within bibliometrics.

### Journal metrics

One of the most recognized accomplishments in the field of scientometrics is the development of the Impact Factor and the work of Eugene Garfield (4). Garfield first described the Impact Factor in 1955 as a method of selecting journals for inclusion in a genetics citation index he had been developing. This eventually resulted in the publication of the Science Citation Index in 1961 as a means of linking articles together via their references. Since it was first described, journal Impact Factor has developed into a widely used bibliometric indicator.

Around the same time, another key figure, Derek De Solla Price, was working on the study of the exponential growth of science and the citation activity of scientific literature. He published several papers describing the key elements of scientometric analysis, including work on patterns of communication between scientists and the overall history and study of science itself.

There was tremendous growth in the scientometric literature in the 1960s (Herubel 1999) (5) and from this point forward the

field of scientometrics developed and differentiated into several specializations. These were brought together by the launch of the first journal devoted to the field, *Scientometrics*, founded and edited by Tibor Braun of the Hungarian Academy of Sciences. One of the most notable developments was citation analysis. Once a laborious manual job few scholars would engage in, the emergence of (print)

databases allowed citation patterns to be studied with relative speed and ease.

In the next issue, we explore scientometrics' transition into the 21st century: the proliferation of databases, new author-focused indices and the impact of the Web.

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