

# Citation Based Indicators in Evaluation of Quality and Performance of Research and Researchers

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## INTRODUCTION

One of the significant criteria for evaluation of the scientific activities of researchers, universities and organizations is evaluation of their scientific productions. However, in this evaluation, the most considerable point is neither the mere number of scientific works (production) nor the count of citations their works may receive. None of these factors alone can illustrate the quality of the researcher's work (scientific activity). Therefore a combination of these two factors may be considered to reach a fair judgment. Various indexes have been suggested by the researchers from different fields to create an impartial evaluation index guaranteeing the inclusion of both of the quality and quantity aspects of the scientific productions of the researchers, organizations along with the impact of them as sources and assets of scientific production on their field as whole.

## BACKGROUND

Scientific citation to the paper is one of the indicators for identifying the rank/impact of the article among other publications in its field, as of the most significant criteria for assessment of scientific productions. Citation analysis is the bibliometric measures to assess the scientific literature based on citation count (Ziman, 1968). Citation analysis can help to determine the basic and fundamental production of a scientific field, identifying effective ideas and works by tracking published materials and analyzing the correlation between the citations.

A citation occurs when a published work 'cites' or directly refers to another published work, including the full reference of the latter within a reference list. These citations enable authors to acknowledge their intellectual debts (Van Noorden, 2010). Although citations are normally considered to originate in a journal article, they can also be found in so-called 'gray literature' including books, government publications, professional body documents, MSc and PhD theses, web articles, podcasts, newspapers and magazine articles. The presence and number of citations are frequently used to assess the influence of a particular article, author, journal or field of research. While it is acknowledged that the number of citations do not necessarily correlate with article quality, nevertheless a high number of citations for a particular article is suggestive of utility by other researchers and as such is an example of an academic impact measure (Nightingale & Marshall, 2012).

A wide range of research metrics (objective indicators) are now available to quantify notions of academic impact, profile and scientific quality, yet researchers from a range of disciplines are increasingly questioning the validity and reliability of these analytical tools (Van Noorden, 2010).

Citation analysis is an integral component of journal ranking criteria and is increasingly used to assess the impact of individual researchers and their institutions. It is important to have an understanding of how citation behaviors can be influenced. Seglen, an expert in information science has studied these behaviors and identified that higher citation rates are consistent with:

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- Articles in the English language.
- Generalist areas rather than specific applied disciplines.
- Review articles rather than original research.
- Cutting edge articles with a short lifespan.
- Longer rather than shorter articles.
- Articles regarding established rather than emerging disciplines.
- ISI-indexed journals (Seglen, 1997).

However, citation analysis is not a perfect tool for assessing the quality of research. Citation analysis depends not on the quality of research but also on the scientific articles and citation behavior. Mooij asserted that citation analysis leads the researchers with poor researches to withdraw from doing research or to strengthen their work and change to good researchers, because poor researches receive no citation (Mooij, 2006).

In this section, all the major traditional citation based indicators such as the Journal Impact Factor, Discipline Impact Factor, ImmediacY-index, Literature Obsolescence, the new scientometrics indicators like H-Index, G-index, Y-index, Mathew Value, as well as the local and specific indexes such as: Research Assessment Exercise, Crown Indicator, Citation Z Score that may be used by specific regions and fields will be covered. The strengths and weaknesses of each will be argued and the role they play in ranking of a researcher, journal and article will be explained and the important point which plays a role in receiving the highest rank will be discussed.

## TYPES OF CITATION-BASED INDICATORS

### The Traditional Citation-Based Indicators

Traditional scientometrics indicators are known as citation analysis indicators. They include Journal Impact Factor (JIF), Discipline Impact Factor (DIF), Immediacy index, the half-life or literature obsolescence (Hirst, 1978; Glanzel & Moed, 2002).

## Journal Impact Factor

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Journal Impact Factor is one of the most common traditional citation indicators and citation analysis tools which is known with other names such as Impact Factor, Journal influence, Citation Rate, and Impact. This index was introduced by Eugene Garfield (1955), the founder of the Institute for Scientific Information (ISI), to measure the influencing level of one journal on the other related journals and it was used for the first time for quantifying publications of science citation index (SCI) in 1963. This index is one of the most important productions of Institute of Scientific Information (ISI) (Garfield, 1972).

### *Applications of Impact Factor*

1. Journal administration. At first, it was devised just for management of journals, making decision to add the table of contents of reputable journals in Current Content (CC) but not for assessing the value of all the publications, researches and authors.
2. To study the influence of a journal on the other related journals
3. Quantification of the publications of Scientific Citation Index (SCI)
4. At present, this index is used as an assessment tool in various and different cases such as ranking and evaluating of the countries, universities and scientists (Garfield, 2005).

### *Calculation of Impact Factor*

The impact factor of a journal is the average number of citations received per paper published in that journal during the specific period of two preceding years. Garfield considered this period two years, because usually 20% of all the references (citation) to published materials occur in the first two year period. Impact factor is a ratio between citations and recent citable items published. Thus, the impact factor of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years. For example the calculation of JIF for year 2012 is as follows:

Journal Impact Factor = Number of citations received by articles in journal X in years 2011 and 2010

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