CHAPTER 36

Journal Management Issues Based on Citation Metrics

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Abstract: *The significance of scientific journals in transmission of scientific findings is well known to the society. Since the evolution of scientific journals, they continue to occupy the predominant position in transmitting the results of scientific research. Hence, the study of scientific journals and the way they function become the core component in the area scientometrics. The research workers in a discipline need to access and utilize the results of the research in their specialization. The identification of core journals in a field of knowledge gives priority in classification of scientific journals. Journals are classified, which enables the scientists to find the journals in their specialization. This article analyzes the possible journal management issues.*

Keywords: Journal Citation Measures, Journal Management, Journals Classification

1. Introduction

The output of scientific efforts is many including new products, inventions and discoveries that get reflected in the form of new publications such as papers, conferences, reports, patents etc., The most significant among them is journals and hence they are given priority is scientific literature studies. The study of journals has been a prime concern for scientometricians since long. Studies in journals of science offer greater benefits to scientists, science managers, journal editors, journal users etc.

The volume and the extent of utilization of scientific journals by the scientific community is typically considered as the index of the significance of the journals. The identification or the measure of the quality or importance of the journals is required for various purposes by different categories of users such as information users, authors, journal editors, librarians, science policy planners and administrators etc.

Information users need to find the quality or value of journals in their fields as all published literature is not equal. In the state of journal literature flood, no one could consume the entire produced knowledge. Selection of items of journal information is based on the merit of the journals. Authors need to understand the level of the journals so that they can find the most appropriate journals for their papers.

2. Measuring the Impact of Journals

The strength of the Impact Factor lies above all in its independence of the "*size*" of the journal, its comprehensibility, stability and seeming reproducibility. On the other hand, some obvious flaws, but especially the already mentioned uninformed use have provoked critical and controversial discussions about its correctness and use. In this context, it has also to be mentioned that ISI's somewhat poor background documentation concerning the processing of the data presented in the JCR cannot convince critical users. In particular, the impact factor and related journal impact measures can readily be reproduced from the data presented in the Journal Citation Reports (JCR), however, these very data proved at large not to be reproducible.

Although it is difficult to theoretically define the concept of (journal) impact, there is a widespread belief that the ISI Impact Factor is affected or 'disturbed' by factors that have nothing to do with (journal) impact. Consequently,

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several attempts have been made to improve the impact factor or to develop additional or alternative journal citation measures. Some of the main modifications relate to all of the '*elements*' mentioned in the above-mentioned mathematical interpretation.

Because of its comprehensibility, robustness and its fast availability, the impact factor became very quickly popular and widely used. The Impact Factor is comprehensible because it measures the frequency with which an average article published in a given journal has been cited in a particular year; it is robust because the annual changes of the journals' Impact Factors proved to be no dramatic so that in practice one or two years old impact factors are sometimes used for evaluation purposes where more recent indicators are not available. On the other hand, time series can be used to monitor the evolution of journals' citation patterns. The fast availability of the Impact Factor, finally, is due to the fast indexing, data processing and the distribution of ISI products. These are in short the most important technical advantages of the Journal Impact Factor.

On the other hand, according to a number of authors both the Impact Factor and especially the Immediacy Impact have several serious flaws the consequences of which some of them are mentioned.

1. There is no normalisation for reference practices and traditions in the different fields and disciplines [Pinski, G., Narin, F, 1976].

2. "*There is no distinction in regard to the nature and merits of the citing journals*" [Tomer, C. A., 1986].

3. There is a bias in favour of journals with large papers, e.g. review journals tend to have higher impact factors [Pinski , G., Narin, F].

4. Citation frequency is subject to age bias [Asai, I. 1981., R Rousseau, Urs, Schoepflin, Glänzel, Wolfgang, 2001, Moed, H. F., Van Leeuwen , TH. N., Reedijk, J. 1998].

5. There is no indication of the deviations from this statistic (see, for instance, [Schubert and W. Glänzel, 1983]).

6. The average time for a journal article for publication to peak in citations is not always two years, or as Garfield (1986b) writes "*if we change the two-year based period used to calculate impact, some type of journals are found to have higher impacts*". **(**cf. also [Glänzel., Schoepflin. 1999, Moed, H. F., Van Leeuwen , TH. N., Reedijk, J]).

7. One single measure might not be sufficient to describe citation patterns of scientific journals.

8. The concept of citable document is not operationalised adequately. As a result, journal impact factors published in ISI's Journal Citation Reports are inaccurate for a number of journals [Moed, H. F., Van Leeuwen , TH. N., Reedijk, J. 1995, Moed, H.F., Van Leeuwen, TH. N. 1996].

In the calculation of JCR impact factors, errors are made due to incorrect identification of (cited) journals, for instance for the journal Angewandte Chemie – International Edition [Braun, T, Glänzel ,1995, van Leeuwen, ,1997].

The above documentation enables to convince the arguments to supplement or modify or extend or customize the impact factor. Bibliometric indicators currently used to examine and evaluate the published knowledge production are primarily based on impact factors of journals covered by Science Citation Index database and published annually since 1975 in the Journal Citation Reports. This concept has been introduced by Garfield [Garfield, E] as a measure of the average citation frequency for a specific citable item (article, review, letter, discovery account, note, and abstract) in a specific journal during a specific year or period. Commonly, the impact factor of a journal is defined as the ratio between citations and recent (previous two years) citable items published, or, in other words, as the average number of citations in a given year of articles published in that journal in the preceding two years. The impact factor has the meaning of number of citations received by the "*average article*" during the considered two-year period. There are valid reasons for the extension of the period to more years as the restricted window is not found justiable in many studies. [Moed, Pichappan, P. 1993]. Thus the refinement and application of impact factors for journal

management is going in a large scale.

Developed originally from the need to compare the journal influence the performance, the impact factor provides nowadays the main quantitative tool for ranking, evaluating, categorizing, and comparing journals. Thus, it provides librarians a tool for the management of journal collections and publishers a quantitative evidence in evaluating the position of their journals. But data can as well be ranked to reveal interesting facts about individual or collective performance and trends, such as highly cited papers and authors hot papers, hot scientists, most active laboratories, institutions or research fronts [Garfield, E] up to countries and world science mapping and policy [Garfield, E, Katz J. S, Braun T.].

Perhaps the most important use of impact is in the process of journal evaluation. The impact factor can be used to provide a gross approximation of the prestige of journals in which individuals have been published. This is best done in conjunction with other considerations such as peer review. Again, the impact factor should be used with informed peer review" [Garfield, E]. Methods and techniques are currently designed for evaluation and comparison of research groups and individual scientists, such as the so called Expected Citation Rates (ECR) etc. [Garfield, E].

Thus, particularly direct and transparent cumulative scientometric indicator appears to be the sum of the (journal impact factor, (article author number, or, shortly, extended over the whole list (assumed statistically significantly) of scientific publications of the assessed individual. Obviously, this individual cumulative factor has the meaning of an author's total number of citations per author in the first two years after publication and, consequently, its unit is cites/author at this paper age. Similarly, the average journal impact factor pertaining to an author is a measure of his number of citations per published paper, with the corresponding cites/paper unit.

The use of journal impact factors, across countries, has created much anxiety. Until a few years ago, it was difficult to get someone to pay attention to citation data. But now emphasis has been made to find how one or more papers used citation analysis and impact factors. Many of these papers, however, attacked any quantitative studies as though they were synonymous with the use of journal impact factors.

Thus the use of journal impact factors as surrogates can be justified in certain situations. The use in these cases is simply another way of determining that a scientist had or had not published in a journal of minimal prestige. The mere acceptance of a paper in such a journal makes a statement. Even if that paper is never cited, the fact that a respected peer-reviewed journal accepted it means that the scientist met some minimum international standard. Now we know that this generalization is not always true. We can see papers that should never have been published. But we hope that the peer review process minimizes the publication of trivial and insignificant papers in science. There are varied perceptions in deciding the question of using journal impacts as surrogates for real citation evaluation. Journal impact factors, which are published annually in *SCI Journal Citation Reports*, are widely regarded as a quality ranking of journals and used extensively by leading journals in their advertising.

Clearly, a high number of citations means a major impact in the specific field or a high utility. However, it is critical to take into account, among other aspects, that publication and citation rates, as well as the peak impacts, vary widely from field to field, and among different disciplines, and we need to know what the average citation rate is within a field and a discipline to assess an individual. A convenient way to consider this requirement consists in the use of the relative ranking number, of the journal within its discipline instead of the impact factor, as far as, according to many authors there exists differences with respect to the size of the discipline.

The bibliometric indicator equivalence of measuring journals belonging to various disciplines is required with higher stability as compared to the corresponding impact factor. In order to meet the increasing needs for extension of journal impact factors for a variety of purposes this work presents a completed and solid version of the pilot study [Sarasvady, S., P. Pichappan., 2001].

The above presentations lead to the understanding that there is a need to measure the quality as well as the standing of journals in different disciplines. Access to quality journal content is significant as it promotes ultimately the

quality of research. Thus the current aim of this work is to know and understand the rank and standing of journals in different disciplines. Disciplinary orientation of subject journals is being carried out by many databases including the ISI Journal Citation Reports (JCR). The standing of journals in disciplines is measured by the objective citation impact and peers' subjective assessment. Since the subject labeled journals are classified by JCR, it is imperative to classify multidisciplinary journals. It has been widely accepted and proved that many multidisciplinary journals have impact in disciplines and specialities. However they are classified just as multidisciplinary which fails to recognize their contribution in specialities.

3. Extension and Modification of Impact Factors

It has been estimated that more than 2 million new research articles published each year in medical and scientific journals and it is difficult for scientists, and policy analysts to keep up with them. Furthermore, many published reports are of poor-to-average methodological quality [Cole, S., Cole J. R., Simon G. A. 1981., Ernst, E., Saradeth, T., Resch, K. L. 1993., Garfield, E, Calza, L., Garbisa, S. 1995]. And most scientific articles are never cited. [Taubes, G. 1993].

Researchers of a discipline approach to facilitate identification of core information in journals that are likely to publish high-quality research. Peer-review and bibliometric methods (such as journal citation rates, impact factors, circulation, manuscript acceptance rates, and indexing on secondary services) may be useful in evaluating the quality of a journal**.** [Vinkler, 1988, Maffulli, N. 1995, Seglen, P.O.1992, Seglen, P.O. 1994, Gordon, M.D.1984] However, these methods are controversial due to potential biases in citation, impact factor, and inherent limitations of the sources of information used to calculate them [Braun, T., Glänzel, W., Grupp, H. 1996, Magri, M-H., Solari, A. 1996, Moed H.F, Van Leeuwen, Moed, H.F., Van Leeuwen , TH. N., Reedijk, J. 1996]. Currently, none of these bibliometric parameters have been validated as predictors of journal quality.

Efforts have been made to evolve suitable alternative methods for evaluating research such as citation rates and journal impact factors, which seem to be quantitative and objective indicators directly related to publish science. The citation data are obtained from a database produced by the Institute for Scientific Information (ISI) in Philadelphia, which continuously records scientific citations as represented by the reference lists of articles from a large number of the world's scientific journals. The references are rearranged in the database to show how many times each publication has been cited within a certain period, and by whom, and the results are published as the Science Citation Index (SCI). On the basis of the Science Citation Index and authors' publication lists, the annual citation rate of papers by a scientific author or research group can thus be calculated. Similarly, the citation rate of a scientific journal–known as the journal impact factor–can is calculated as the mean citation rate of all the articles contained in the journal. [Bourke, P., Butler, L. 1996]. Journal impact factors, which are published annually in SCI Journal Citation Reports, are widely regarded as a quality ranking of journals and used extensively by leading - journals in their advertising.

Since journal impact factors are so readily available, it has been tempting to use them for evaluating individual scientists or research groups. On the assumption that the journal is representative of its articles, the journal impact factors of an author's articles can simply be added up to obtain an apparently objective and quantitative measure of the author's scientific achievement. The increasing awareness of journal impact factors, and the possibility of their use in evaluation, is already changing scientists' publication behaviour towards publishing in journals with maximum impact, [Garfield, E, Vinkler P. 1996] often at the expense of specialist journals that might actually be more appropriate vehicles for the research in question.

There is widespread application of journal impact factors in research evaluation, a critical examination of this indicator seems necessary. Many researchers have investigated the degree of creditability and reliability of impact factors for assessment and conclude with extensive documentations on the limitations. While summarizing the limitation of impact factors, Seglen has given a comprehensive presentation of the studies that investigated them. [Maffulli].

4. Journal Impact Factors depend on the Research Field

Among the above documented limitations, the failure of identifying the disciplinary differences is crucial as the application of impact factor to evaluate the papers in different discipline journals without considering the differences would affect the tenure and other payoffs.

Citation habits and citation dynamics can be so different in different research fields as to make evaluative comparisons on the basis of citation rate or journal impact difficult or impossible. For example, biochemistry and molecular biology articles were cited about five times as often as pharmacy articles. [Seglen, Per O. 1997]. Several factors have been found to contribute to such differences among fields of research.

The citation impact of a research field is directly proportional to the mean number of references per article, which varies considerably from field to field (it is twice as high in biochemistry as in mathematics, for example. [Narin, F. Hamilton, K.S. 1996]. Within the arts and humanities, references to articles are hardly used at all, leaving these research fields (and others) virtually uncited, [Moed, H. F, Burger, W.J.M., Frankfort, J. G., Van Raan] a matter of considerable consternation among science administrators unfamiliar with citation kinetics.

In highly dynamic research fields, such as biochemistry and molecular biology, where published reports rapidly become obsolete, a large proportion of citations are captured by the short term index used to calculate journal impact factors, as previously discussed [Hamilton, D. P. 1990], but fields with a more durable literature, such as mathematics, have a smaller fraction of short term citations and hence lower journal impact factors. This field property combines with the low number of references per article to give mathematics a recorded citation impact that is only a quarter that of biochemistry. [Hamilton, D.P. 1991] In young and rapidly expanding research fields, the number of publications making citations is large relative to the amount of citable material, leading to high citation rates for articles and high journal impact factors for the field [Marton, J. 1985]**.**

In a largely self contained research field, the mean article (or journal) citation rate is independent of the size of the field**,** [Moed, H.F, Burger, W.J.M., Frankfort, J.G., Van Raan Ibid] but the absolute range will be wider in a large field, meaning higher impact factors for the top journals. Leading scientists in a small field may thus be at a disadvantage compared with their colleagues in larger fields, since they lack access to journals of equally high citation impact.

Most research fields are, however, not completely self contained, the most important field factor probably being the ability of a research field to be cited by adjacent fields. The outcome of an evaluation based on impact factors in a given discipline will therefore depend on the position of research groups or institutions along the other related disciplines.

In measures of citation rates of articles, attempts to take research field into account often consist of expressing citation rate relative to some citation impact specific to the field. [Vinkler, P. 1996] Such field corrections range from simply dividing the article's citation rate by the impact factor of its journal [Gomperts, M.C. 1968] (which punishes publication in high impact journals) to the use of complex, author specific, field indicators based on reference lists [Schubert, A.., Braun, T. 1996] (which punishes citations to high impact journals). However, field corrections cannot readily be applied to journal impact factors, since many research fields are dominated by one or a few journals, in which case corrections might merely generate relative impact factors of unit value. Even within large fields, the tendency of journals to subspecialise with certain subjects is likely to generate significant differences in journal impact: in a single biochemical journal there was a 10-fold difference in citation rates in subfields.

Thus the major inference we gain from the studies on the correction of impact factors is that the continuous and rigorous methods are essential to improve the efficiency of the bibliometric indicators. One such improvement is the study of contribution of journals other than that speciality so that research evaluation based on the understanding of ‘*other journals*’ contribution is meaningful.

5. Concept of Relative Impact

Assessment of units of items (such as authors, journals etc) is done in an ideal way by comparing the individual unit in relation with other units. Such an assessment underlies the concept of measuring the growth in relation to the growth of other members of the population. Growth is a natural phenomena in the universe. Members of a population exhibit this character and they are expected to have a reasonable growth. The growth is measured in terms of the percentage of increase from the previous observed period or in comparison with similar individuals.

Scientometrics lay down emphasis on relative growth or the growth of an individual or unit in relation with another. Bibliometric scores deduced from relative impact or growth are of two types. One is the growth of the individual unit in relation to similar comparative unit; and the score obtained by dividing the observed number of citations by the expected number of citations [Moed, H. F., Burger, W. J. M., Frankfort, J.G., Van Raan, A. F. J. 1987] for a given period of time. The larger is relative impact, higher the quality of research.

6. Content Relationship between Papers

Science and the way that it is done today are multidisciplinary. Charles H. Townes, the physicist whose work in the 1950s led to the invention of the laser, pointed out in a 1993 talk to an International Astronomical Union symposium that, "*in a sense, every science is multidisciplinary because almost every subject calls upon ideas from many different disciplines*." [Lewison, G., Anderson, J., Jack J.1995]**.** He further notes that because basic science is often integrated with applied science, an additional level of interactions between different specialties occurs.

The significant factor that addresses the content relation is the citations. The citations are the tools that bring and reflect the naturally existing relations between papers and consequently the discipline relations.

When papers are related in content, we need to understand the content relations so that the papers can be mapped and cluster of papers that constitute disciplines and specialities emerge. For paper and document mapping, citation data particularly the citing and cited data is highly useful and many studies use either directly or indirectly the citing and cited data. For measuring the discipline standing of the journals, one of the important parameter is the citing and cited data. The significance of cited and citing data is investigated in the recent past.

It has been understood that citing and cited references have a semantic link and related in content. Different studies have offered disparate findings on the validity of this assumption, and a like number of theories have been offered to explain those findings. Since an understanding of the interplay between citing and cited articles is key to use for discipline impact measures a look at the concept is essential.

Publications with a citing relationship as well as bibliographically coupled publications--those that have one or more cited documents in common--are content-related. The cognitive resemblance, or subject-relatedness, between citing and cited publications as well as the relatedness of bibliographically coupled publications are studied extensively and found a strong possible correlation between them. The test by Peter [Rousseau, R., Van Hooydonk, G. 1996] examined cognitive resemblance with word-profile similarity and mapping. The study supports the results of an earlier study by Braam *et al.* [Townes, C. H. 1994] Shows relatively strong cognitive resemblance within consensus groups for agricultural biochemistry and chemoreception.

Finding a self-contained topic in science is difficult these days. One topic will touch on another, which will in turn bridge a gap between disciplines, and so on. Interconnections among disciplines abound. The widely used tool to study the multidisciplinary journals is the Institute for Scientific Information's *Science Citation Index which* is a convenient tool for navigating through the multidisciplinary and interdisciplinary literature.

One of the practical advantages of using the *SCI* for a literature search is that it has always taken these interconnections into account. The search strategies are not limited to keywords or phrases, but can be directed to

include the connections created through the references made by the authors of a given article as well as the citations to that article by authors of subsequent articles. (As you will recall from previous essays, the cited work is a paper or book that has been mentioned in the references of other works, and the citing work is the one that contains the references.) The intricate web of connections that results can reposition a topic by virtue of its ties to other fields.

The multidisciplinary nature of science is aptly matched with the multidisciplinary content of the *SCI*. In fact, the multidimensional and chronological cumulative character of the *SCI* makes it even better suited to many literature searches involving complex scientific topics. Today most research touches a variety of disciplines and methodologies. And often the social implications are important to recognize. To be fully cognizant of these interconnections, the researcher can look to the *SCI* and its companion *Journal Citation Reports* as comprehensive sources of information.

7. Summary and Conclusion

We presented an improved bibliometric method for the objective and transparent assessment of disciplinary relation the multidisciplinary journals have in research publications, and for monitoring scientific, particularly interdisciplinary developments. First, we focused on the detailed analysis of disciplinary performance of the multidisciplinary journals in comparison with disciplinary journals. We applied our approach at the journal level and showed that this level is the crucial starting point of the "*search for disciplinary standing*".

We demonstrated that our improved methods are very informative and we concluded that advanced bibliometric methods are, particularly at the level of journals, an indispensable method in evaluation studies.

A number of specific problems – and opportunities as well – for the application of bibliometric analysis using citation data were addressed. In the recent period, monitoring of scientific (basic and applied) developments, advances in bibliometric mapping techniques are promising. They are unique instruments to discover patterns in the structure of a research field. By adding "*communication linkages*" based on the extent to which publications in a specific sub-field cite publications in other sub-fields, one can able to identify processes of knowledge dissemination [Raan, A. F. J van; Noyons, E. C. M., 2002]. Time-dependent analysis reveals the dynamics of scientific developments, with the possibility to focus on interdisciplinary developments. This is important, as we know that multidisciplinary cross-roads of basic and applied scientific fields are often the loci of discovery and technological innovation.

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