



## The meaning of the Impact Factor

Eugene Garfield<sup>1</sup> (*Institute for Scientific Information, ISI, USA*)<sup>2</sup>

(Recibido 19 junio 2002 / Received June 19, 2002)

(Aceptado 18 septiembre 2002 / Accepted September 18, 2002)

**ABSTRACT.** The impact factor and other bibliometric indicators are currently utilized in most countries to evaluate institutions, scientific research, entire journals, and individual articles. This article addresses some of the most frequently asked questions about the impact factor and its application. The impact factor's origin and methods of calculating it are examined. Also, discussed are the effects of the impact factor on the following issues: journal and article quality; ISI journal selection criteria; acceptance difficulties; comparison of journals across disciplines, and language of publication. Finally, the article examines the generalization of a journal's impact factor to the quality of its individual articles, as well as ways to enhance the impact factor of a journal.

**KEYWORDS.** Impact Factor. Journals. Scientific Investigation. Evaluation.

**RESUMEN.** El factor de impacto y otros índices bibliométricos son utilizados en la actualidad, en la mayoría de los países, para evaluar la investigación científica: proyectos de investigación, revistas, artículos, investigadores e instituciones. En el presente artículo se responden a las preguntas más frecuentes sobre qué es el factor de impacto y cómo debe ser utilizado. En concreto, se habla de su origen, de los criterios que debe cumplir una revista, del factor de impacto como criterio de evaluación, de la relación entre la calidad de las revistas y el factor de impacto, de la evaluación de la calidad de las publicaciones, del período de evaluación para el cálculo del índice de impacto, del

<sup>1</sup> Correspondence: The Scientist LLC, 3535 Market Street, Philadelphia, PA 19104-3302. USA. E-Mail: Garfield@codex.cis.upenn.edu

<sup>2</sup> Eugene Garfield is President of The Scientist LLC, Chairman Emeritus of ISI, and Past President of American Society for Information Science and Technology.

calculo del índice de impacto, de la comparación entre revistas de diferentes campos científicos, de la generalización del factor de impacto de una revista a cada uno de los artículos publicados en ella, de la relación entre el factor de impacto y la dificultad de publicar, del idioma en que publican las revistas y de cómo mejorar el factor de impacto de una revista.

**PALABRAS CLAVE.** Índice de impacto. Revistas. Investigación científica. Evaluación.

**RESUMO.** Actualmente na maioria dos países, o factor de impacto e outros índices bibliométricos são utilizados para avaliar a investigação científica: projectos de investigação, revistas, artigos, investigadores e instituições. No presente artigo responde-se às perguntas mais frequentes sobre o que é o factor de impacto e como deve ser utilizado. Concretamente, fala-se da sua origem, dos critérios que deve cumprir uma revista, do factor de impacto como critério de avaliação, da relação da qualidade das publicações, do período de avaliação para o cálculo do índice de impacto, do cálculo do índice de impacto, da comparação entre revistas de diferentes áreas científicas, da generalização do factor de impacto de uma revista a cada um dos artigos nela publicados, da relação entre o factor de impacto e a dificuldade em publicar, do idioma em que publicam as revistas e como melhorar o factor de impacto de uma revista.

**PALAVRAS CHAVE.** Índice de impacto. Revistas. Investigação científica. Avaliação.

### Origin

*When was the impact factor conceptualized, and what was its intent?*

From the earliest experiments with the Genetics Citation Index and the early Science Citation Index we compiled so-called journal citation indexes, in contrast to Author citation indexes. Once we had sorted the files by cited journal it was a logical step to compile the statistics which we used in our journal selection procedures. However, my colleague Irving H. Sher and I were not satisfied with the raw data and wanted to normalize them so that we could compare the effectiveness for example, of a relatively small journal like Annual Review of Biochemistry with a very large journal like the Journal of Biological Chemistry. So you see the impact factor was created to give small journals a better chance of selection.

### Criteria for journal inclusion in ISI. This has been covered in several publications

*What criteria should journals meet to be included in ISI databases?*

See Garfield, E. "How ISI selects journals for coverage", Reprinted in: Current Contents #22, May 28, 1990; reprinted in Garfield, E. "Essays of an Information Scientist" V.13, p.185-193 (1990) file:

<http://www.garfield.library.upenn.edu/essays/v13p185y1990.pdf>

### **Impact factor as an evaluation tool**

*The impact factor and other bibliometric measures are used in most countries to evaluate the quality and prestige of research centers and authors. What factors influence this process?*

This is not a well formed question. Research administrators and others want objective criteria for evaluating the past performance of individuals, departments and institutions—indeed entire countries. The alternatives are subjective so-called peer reviews by committees that invariably has strong biases. Citation analysis is not perfect but after so many years it has achieved a level of standardization that permits one to obtain informed views of the influence or impact of groups mentioned above. By balancing publication counts with citation counts one can get a better picture of performance. The journal impact factors enter the picture when an individual's most recent papers have not yet had time to be cited. So the journal impact factor becomes the surrogate. The basic assumption is that if you get published in high impact journals that probably says something about the general quality of your paper. However, it is no guarantee it will be cited.

In some studies just the fact that a researcher got published in a good journal is enough evidence that the research may have had some international significance. There were cases where huge research grants were going to researchers with political connections but not a shred of evidence of decent research output. It is very easy, in many countries, for entrenched researchers to hide their ineffectiveness by publishing in local journals with little or no external peer review.

### **Quality of a journal and the impact factor**

*What is the relationship between the quality of a journal and the impact factor?*

Quality—like beauty—is often in the eyes of the beholder. However, numerous studies have shown that the best quality journals as perceived by interviews or questionnaires with scientists demonstrates that these journals also turn out to be among the highest in impact within their particular journal category or specialty. Since the advent of the Journal Citation Reports of ISI impact has become an accepted standard of quality.

What one means by quality can vary. There are undoubtedly some high quality articles that appear from time to time in low impact journals, but human behavior being what it is, scientists generally know when they have something really important to report, and send those articles to the better known, higher impact journals. This of course is a vicious circle but there is nothing that can be done to prevent that as long as author's perceive the necessity for publishing in the journals that will give their work the greatest exposure to other scientists.

### **Evaluation of journal quality**

*How should the quality of a journal and scientific articles be measured?*

Citation analysis and ranking by impact is the best method I know which should then be combined, if possible, with informed peer evaluation. The latter however is very expensive. Decades ago it was found that the NRC of the USA conducted multi-million dollar surveys of the best departments in each specialty. Invariably the results did not differ significantly from the much less expensive citation evaluation.

### **Time lapse for calculating the impact factor**

*Why is the impact factor based on two-year citations? Why not use longer periods of time?*

The two year period was chosen because in the fields that were of greatest interest to the readers of Current Contents, and later of the SCI, 25% of citations were accounted for in the year of publication plus the two previous years. The primary fields of interest were molecular biology and biochemistry. However, even for fields for which only 15% of citations are included the ranking that results from the impact factor may not change much. We also did not want to wait that many years to see how new journals were being cited.

However, nothing prevents the user of JCR from calculating three year or five year impact factors. I have done even seven year and 15 year calculations. These kinds of data are also available in ISI's Journal Performance Indicators, a separate subscription service from JCR.

### **Calculating the impact factor**

*Journal "X" has 200 citations in mostly low impact journals and Journal "Y" has about the same 200 citations in mostly a high impact journals, and they both are the same impact factor. Could one argue that journal "Y" should be assigned a higher impact factor since it has been cited in high impact journals? Should there be a way to take this into account when calculating the impact factor?*

This is an intriguing proposition. I find it hard to believe, however, that an article which is cited mainly in a low impact journals is going to compare well with an article that is cited in mainly high impact journals. Of course the situation is never quite that clear cut. I would say that any article cited 200 times is one that should be called to the attention of a wider audience. If I were the editor of a high impact journal I could perhaps make an argument that a paper with 200 citations that was "buried" in a low impact journal, ought to be considered for reprinting. However, this is indeed hypothetical. But considering that over one million articles are published each year such an occasional anomaly is possible. The advent of the internet may increase awareness of such high impact articles.

As we approach this “open archives” type of situation it will be even more critical for authors to promote the awareness of their articles by sending them to colleagues worldwide who would have an interest.

### **Comparing journals across discipline**

*Is the impact factor sensible enough to allow meaningful journal comparisons across disciplines? Do you mean “sensitive”?*

In any case, comparisons should not be made across disciplines unless the data are normalized in to take into account the various parameters that affect impact.

### **Generalization of the impact factor of a journal and the articles published in it**

*Generally speaking all articles published in high impact factor journals are associated with higher quality even though some may be of a lesser quality. Is it wrong to generalize the journal impact factor to each of the articles published in that journal?*

It depends upon the purpose of the evaluation. A zero impact paper is not going to look any good whether in a low or high impact journal. But if it was published in a low impact journal one could argue that it was not seen by enough potential citers. The fact is that even in a huge high impact journal today there is no guarantee that it will be cited unless, by one means or another, the author or his peers, have stimulated others to follow up that work. Papers do not get cited in a vacuum. If you write on subjects that interest a lot of people there is a better chance it will be cited. But at the same time there is also more competition for citation.

### **Getting published and the impact factor**

*Does the impact factor make it more difficult to get an article accepted in a journal? In general high impact factor journals have many more manuscripts submitted than they can publish. But in the field of physics some journals reject less than 20% of papers. Obstacles for increasing the impact factor of new journals. If the quality of articles is necessary for generating the impact factor, isn't it difficult for new journals to have an impact factor since authors would prefer to submit their articles to journals with impact factors rather than new, unknown ones?*

I have often observed that for the first one or two issues of new journals the editor has been able to attract papers which eventually are highly cited. There is generally a burst of promotional activity for a new journal and so the articles in the first few issues may attract more than average attention. Obviously this is not a realistic question. The number of new journals testifies to the fact that the impact factor or lack of it does not prevent authors from submitting papers. What may affect them more is the reputation of the publisher for promoting the journal. A member of a professional society in the

USA usually has little doubt that the official journals of the society will be well regarded by the members of the society, who may represent a large percentage of the readers.

### **Language of publication**

*The language in which a journal is published influences the impact factor. For example, the Spanish journals of psychology would have a higher impact factor if the citations they receive in other Spanish journals-not covered by ISI data bases-were included in the calculation of the impact factor. How does one take this factor into account?*

There is no guarantee that this would occur. What percentage of the cited references in these Spanish psychology articles are to non-Spanish journals of psychology? However, it is a question that cannot be resolved unless a way is found to cover the cost of including more non-English language journals in the SCI. Would you say it is more important to include more Spanish, more French, more German or indeed more Chinese and Japanese? Even if all these non-covered journals were in English, and there are plenty of them, the economic factors will have to be taken into account.

*The impact factor has been widely used to measure the quality of research and the prestige of authors and institutions worldwide. Do you see any potential for its misapplication in countries in which English is not the official language (e.g. China)? Is there anything else you like to add or clarify?*

There is always the potential for abuse of these data regardless of the country. Why is China any different than Spain in that respect? Indeed there is a Chinese Science Citation Index now and undoubtedly Chinese journals will also have their impact factors. The main objection to the use of journal impact factors has been mentioned at the outset—when JCR data are used as a surrogate for actual citation counts. This is done because it takes several years for new papers to be cited. However, in closing let me point out that even that assumption is wrong in the case of new original and brilliant work. We often call such papers “hot papers” and it has been shown that such papers will be well cited within one year or less.

### **English language and language of publication**

*Why has publishing in English become synonymous with international prestige and high quality?*

I have never said that. There are plenty of low impact journals in English and many not covered at all. Publishing in English is an indicator that the publisher recognizes that the maximum number of readers can be reached with English.

### **Spanish language publications**

*How does one explain that publishing in Spanish is not considered to be international even though Spanish is the language that most countries have as their official language?*

The languages used by the general population is not relevant here. It is the size of the scientific community in the country or region that matters. At this stage in history English has become the lingua franca of science and commerce. At another time it was German or Latin.

### **Increasing the impact factor?**

*What would you recommend to increase the impact factor factor of a journal?*

The editor must be able to attract authors who publish original and innovative research that captures the attention of the international scientific community. To maximize the impact one needs establish high standards and avoid becoming a dumping ground for mediocre or inferior research. Use an international board of editors. There is a vast literature on how to improve the editorial quality of journals. But nothing will replace innovative, and even good controversial research ideas.