Impact Factor Conundrum

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Nobody envisioned in 1955, when Eugene Garfield introduced the concept of impact factor (IF) as a metric to measure the average number of citations published in a particular scientific journal (Garfield 1955), that this simple mathematically based idea would eventually be completely blown out of proportion.

For those unfamiliar with the terminology, the definition of IF for a specific journal is computed according to the following straightforward equation:

$$\text{IF}(\text{for year } t) = \frac{C}{A} \tag{1}$$

where C = total journal citations during year t of papers published in a prespecified number of years (generally, 2 or 5) immediately preceding t; and A = total number of journal articles published during the same prespecified number of years.

For example, if $t = 2011$ (the latest reported IF), C will contain the citations in 2011 of the articles published in the issues of 2010 and 2009 (for a 2-year cycle) or in 2010, 2009, 2008, 2007, and 2006 (for a 5-year cycle), and A will contain the total number of articles published in 2010 and 2009 for the 2-year cycle, etc. Thus, the 2011 2-year IF is a rough estimate of the number of times the articles published in 2010 and 2009 were cited in 2011.

Inexplicably, it appears that nowadays the scientific success of a journal and its surrounding aura of reputation are closely linked to this magic number. Many journals openly announce their IF on the front pages of their publications to attract submissions. Publishers encourage their editors to have a competitive IF with respect to other similar periodicals. Managers in academic and research circles, being well aware of the popularity of IFs, may make decisions affecting the hiring or promotion of personnel by weighing the number of articles published in highly rated IF journals amid the qualifications of prospective candidates. The list of these perplexing examples can go on and on. I feel that this prominence of IFs in the evaluation of peer-reviewed scientific journals is getting out of control and is creating an IF subculture that, in the long run, may damage more than help the independent nature of scientific publishing.

Many scholars have investigated this peculiar sociological phenomenon, and some have criticized the strong influence that IFs are exerting among the scientific community. It perhaps causes, at some point, prejudiced resolutions in their decision making. Furthermore, the reliability of this IF number is dependent on so many variables that, recently, the conversation has switched to expose the possible unethical manipulation of IFs by journal editors primarily preoccupied with enhancing the prestige of their own periodical. The literature on this particular topic is overwhelming, and the reader only needs to check Google Scholar to discover the proliferation of articles covering this controversial subject.

The problem is presently compounded by the fact that there is not a unique IF. Recently, the long exclusivity of the company Thomson Reuters, the original provider of IFs through their web platform Web of Science (formerly Science Citation Index), was partially eclipsed when Elsevier entered the arena of IF dissemination through their Scopus database. The primary reason for the discrepancy of these two issued IF values rests on the fact that, although these two journal databases overlap, they do not contain exactly the same number of scientific publications. In other words, even though an identical Eq. (1) is used to determine the IFs, their comparison is not, rigorously speaking, a one-to-one relationship. As a consequence of this duplication, it is now necessary that the users of IFs always unmistakably identify to which specific database the IF is referring.

There are other potential flaws with a simplistic equation such as Eq. (1). To shorten the reasoning as much as possible, let us concentrate solely on quarterly journals. For the sake of simplicity, assume that the total number of articles published in a 2-year period is 40 [the denominator A in Eq. (1)]. It is obvious that the probability of achieving a higher IF could be improved when the articles in each quarterly issue during a 1-year period are published in grouped sets of eight (first quarter), four (second), four (third), and four (fourth) as opposed to four, four, four, and eight (fourth quarter). The first option will have more articles available to researchers for a longer time and logically should increase the probability of being cited earlier. Correct? As a result, the following question arises: Should journals publish the same number of articles in every issue? A practical complexity to say the least but an intriguing hypothetical question that should be debated among the defenders of calculating very accurate IFs.

There are tabulations of other ubiquitous numbers that further muddy the issue [e.g., self-citation factor, immediacy index, cited half-life, normalized impact per paper, h-index, eigenfactor metric, and SCimago Journal Rank (SJR) indicator]. It is expected that this race for establishing new metrics to grade scientific journals will continue unabated in the future. However, none of these forthcoming metrics will be perfect, and the current multifaceted and imprecise (if not utterly confusing) situation to dissect the rank of scientific journals will not improve by much.

Before I conclude, I would like to comment briefly on the so-called self-citation factor. This metric indicates how often journals cite themselves. Simply put, it strongly depends on authors who write articles in a journal and cite other articles from the same journal. What is wrong with this you may say? As an example, imagine that we are concerned with a sophisticated scientific domain such as the Antarctic environment. Because of its specificity, assume that there are only three major journals covering this topic. All recognized experts in this field submit their articles to these journals, and remember that these scientists are the crème de la crème on the subject matter. However, one of these three periodicals is considered superior to the other two (and, on top of that, publishes color figures for free). It is obvious that most of the prolific investigators researching this esoteric realm will try to publish in that particular journal first. Therefore, it will not be surprising that the best-recognized authors devoted to Antarctic environmental research will publish in their favorite journal and, necessarily, will cite their own work over and over again from the same journal. Consequently, the journal's self-citation factor will rise steeply. Does this imply that a journal with a high rate of self-citations is less significant in its field, because it was accepted as a niche for a team of reputable

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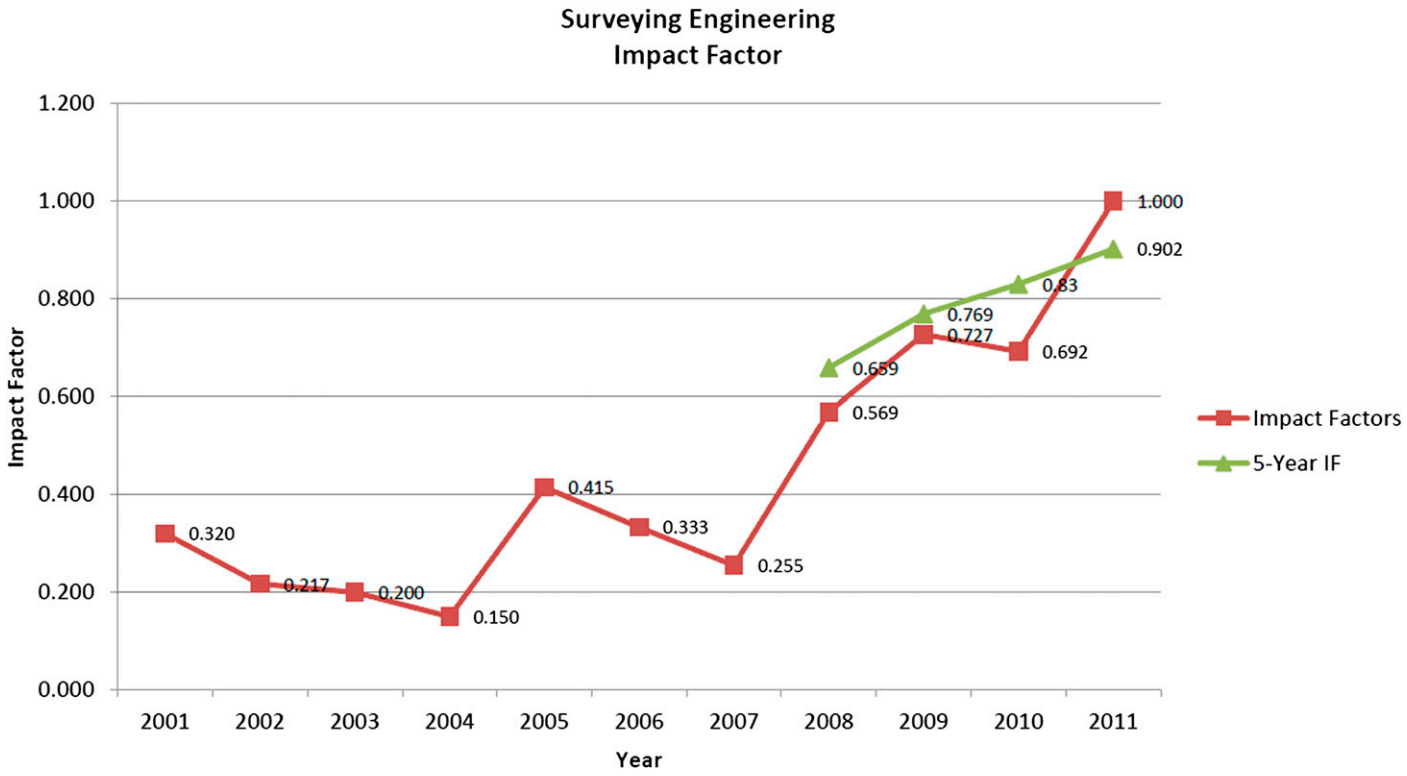

Fig. 1. Plots of 2- and 5-year IFs determined from the Web of Science database

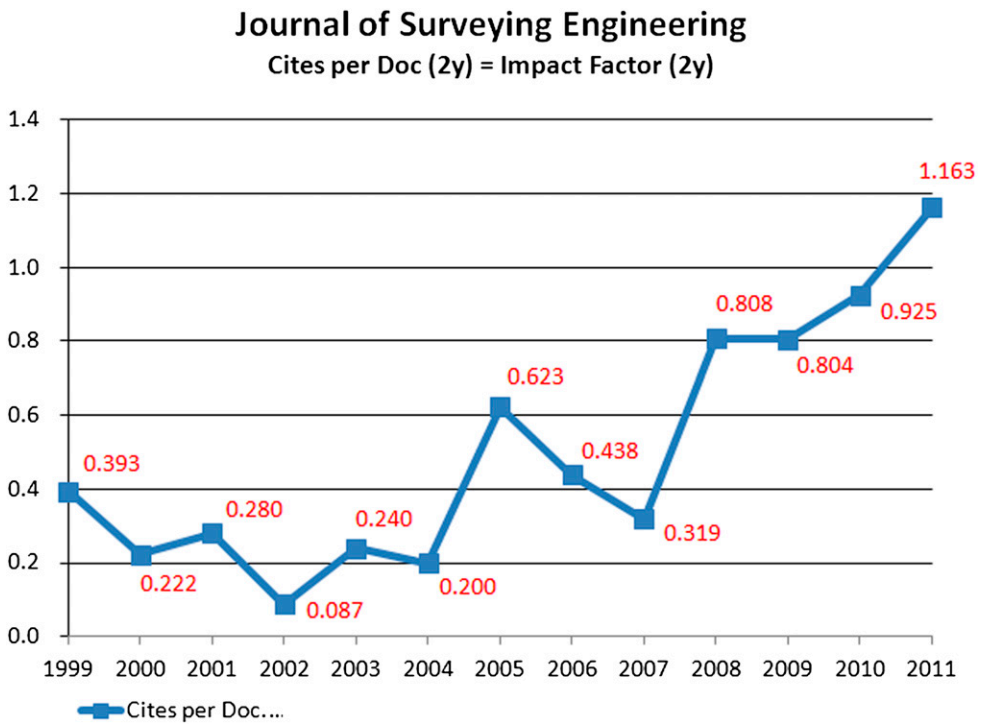

Fig. 2. Plot of 2-year IFs determined using the information provided by SCImago based on the Scopus database

writers? The important point of this elementary exercise is to recognize that all of these metrics are relative and that there is not an absolute conclusive number able to rank the genuine idiosyncrasy of scientific journals. This analogy also brings up other questions: Is a broad category dedicated to civil engineering unequivocal enough to compare journals of similar scope? Should this comparison be divided into subgroups more specific in content to rank particular civil engineering specialties? That is, structural engineering journals should be, ideally, directly contrasted against other structural engineering publications, and a similar approach should be used to

compare other equally delimited fields such as transportation engineering and sanitary engineering.

All of that said, and for what it may be worth, Figs. 1 and 2 show the variation of the IF for the *Journal of Surveying Engineering* for the last few years. At the outset, it should be emphasized that Fig. 1 was produced using journals from the database compiled by Thomson Reuters, whereas Fig. 2 uses the data from Scopus as compiled at the internet portal developed by SCImago Lab (2012). Fig. 1 portrays the IFs for 2- and 5-year periods. Notice that the trend of the 5-year IF, as expected, shows a much smoother variation, because it represents an average over a 5-year period and, consequently, will not generate large pointed peaks and valleys as the 2-year plot does. Regrettably, to this date SCImago only tabulates 2-, 3-, and 4-year IFs; therefore, the 5-year IF could not be directly compared. Fig. 2 depicts the 2-year IF available at the SCImago web platform based on the Scopus journal database. As described earlier, the values of the IFs from Figs. 1 and 2 cannot be equal; specifically, for 2011, their scores are 1.000 (Web of Science) and 1.163 (Scopus). As a curiosity, it should be mentioned that the interactive software provided by SCImago permits the direct comparison of up to four journals of similar scope stored in their database. This is a handy practical tool that resolves the question of how well a journal is doing versus its immediate competitors. Graphically, it is possible to visualize the IF trends of an individual journal against other journals publishing related topics. This is possibly the only rational use of IF—to gauge the overall trend of same-scope journal performance. Impact factors alone should never be used to validate the universal excellence of scientific journals, the merit of individual articles, or the competence of dedicated researchers.

In summary, IFs and any other metric currently in use to rank the performance of scientific journals are only relative indicators, nothing else. Consequently, they should be interpreted with common sense and a large amount of precaution.

References

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