

# EDITORIAL

## CITATIONS, COUNTS, JOURNAL IMPACT FACTORS, AND PROMOTION

Scientific citation counts and journal impact factors will increasingly influence college faculty promotion and tenure decisions. For a couple of decades, citation counts have been influential in promotion decisions in fields of science such as physics and chemistry, but they have rarely been used as a criterion in civil engineering. The trend toward increased use of number-based criteria such as citation counts and impact factors is the result of changes in our society. First, society has become more quantitative, which is evident from the publishing of everything from statistics on quarterback ratings to *U.S. News and World Report* rankings of university programs. Now we have quantitative journal impact factors to replace qualitative but subjective assessments of journal quality. Second, the advances in computer technology have made it much easier to obtain accurate counts. The use of inaccurate hand counts of citations would probably not have been fair in decisions as important as promotion and tenure. Third, in the past, tenure decisions were rarely contested, but as society has become more litigious, universities have needed more quantitative criteria to justify denying tenure. A negative vote by faculty that is assumed to be justified by a general letter stating that the publications are of low academic quality is no longer sufficient. However, a low citation count would be a less disputable criterion than a subjective statement that the person's research results have had little impact on the profession. Also, publishing in journals that have low impact factors would suggest that the articles based on the individual's research were not of sufficient quality to be accepted for publication in journals recognized for their high quality.

The bar for receiving tenure is continually being raised in all academic disciplines. Just a decade ago, four or five refereed publications, research dollars of \$1 million or \$2 million and five reasonably positive external letters would have been sufficient for promotion to associate professor and the awarding of tenure. Now, to receive tenure the faculty member may need 10 articles in journals with good impact factors, more than \$5 million in external support, eight strong external letters of support, a citation count of 20 or more, and the completion of at least one PhD student. When pitted against the promotion packages from young faculty from other engineering departments (e.g., EE and ChE), even these accomplishments may represent a weak case for tenure. In addition to the bar being raised, the criteria used in the evaluation of promotion packages is changing. These changes are worth considering.

The promotion and tenure process in academia is undergoing a significant change. Just one year ago, citation counts and journal quality indices were not criteria used in our promotion and tenure decisions. This year, they were significant factors. I expect in the near future that these quantitative criteria will play a critical role in promotion and tenure decisions. If we are forced to play this game, which will be part of the raising of the bar, success will depend on our ability to develop a sound decision strategy. What follows are a few points to consider by either a person or an academic department in developing such a strategy.

### Measures of Journal Quality

Computer technology has simplified the process of compiling information about individuals and about journals. Given the exponential increase in the number of journals and the extent to which journals have become specialized, promotion and tenure committees rightfully need assistance in judging the quality of journals. Because numerical rankings can be

easily compared, they are a favorite. Promotion and tenure committees can get a general idea of the quality of the journals in which an applicant has published by examining the journal impact factor (IF), the immediacy index (II), and the citing half-life (HL), which are defined as

- IF: the number of current citations to articles published in the two previous years divided by the total number of articles published in the two previous years.
- II: the number of citations to articles published in a given year divided by the number of articles published in that year.
- HL: the number of publication years from the current year that account for 50% of the current citations published by a journal in its article references.

Values of these are available at <http://jcrweb.com> for most scientific journals. The IF attempts to measure the frequency with which the "average article" in that journal has been cited in a particular year. The higher the IF value, the greater the apparent affect that articles from that journal have on future research. The II attempts to measure how quickly the "average article" in a journal is cited. The higher the II value, the sooner articles published in that journal are apparently influencing research, which would be a measure of the relevancy of articles to ongoing research. The citing half-life attempts to measure the age of the majority of articles referenced by a journal and, therefore, is a measure of the shelf life of articles. Journal articles that have a long-term influence on research would contribute to a high value of the HL. While other indices of journal quality could be developed, these provide indices of three important qualities.

Values of a few water-related journals are given in Table 1. These scores are considered to be very good, with IF values below 0.5 not uncommon in many fields. Values of the three criteria are regularly updated; therefore, both multiyear averages and trends may need to be considered when using the indicators to judge the quality of a journal.

The values of these criteria show considerable variation from one field to another, which has important implications when evaluating a promotion package. Should the publication record of someone in a discipline that generally has high IFs and IIs automatically be considered better than that of someone in a discipline with generally low IFs and IIs? Table 2 includes the values for journals in transportation engineering. The IFs and IIs for these journals are considerably below those of the water-related journals in Table 1. A faculty member publishing in transportation journals does not have the same opportunities for publishing in highly rated journals as does the water professional. The quality of the work of transportation engineers publishing in the best transportation journals

**TABLE 1.** Impact Factors (IF), Immediacy Indices (II), and Citing Half-Life (HL) for Water-Related Journals for 1999

Journal	IF	II	HL
<i>Ground Water</i>	1.66	0.14	6.9
<i>J. Am. Water Resour. Assoc.</i>	0.96	0.10	1.7
<i>J. Contaminant Hydro.</i>	1.35	0.48	5.6
<i>J. Hydr. Engrg., ASCE</i>	1.02	0.12	>10
<i>J. Hydr. Res.</i>	0.52	0.04	8.7
<i>J. Hydro.</i>	1.44	0.23	7.9
<i>J. Irrig. and Drain. Engrg., ASCE</i>	0.44	0.11	>10
<i>J. Water Resour. Plng. and Mgmt., ASCE</i>	0.92	0.07	5.9
<i>Nordic Hydro.</i>	0.71	0.10	8.5
<i>Water Res.</i>	1.75	0.19	7.4
<i>Water Resour. Res.</i>	2.06	0.18	9.1

**TABLE 2.** Impact Factors (IF), Immediacy Indices (II), and Citing Half-Life (HL) for Transportation Journals for 1999

Journal	IF	II	HL
<i>IEEE T. Veh. Technol.</i>	0.90	0.11	7.0
<i>ITE J.</i>	0.14	0.10	7.7
<i>J. Transp. Engrg., ASCE</i>	0.15	0.03	6.1
<i>Transp. Res. A-Pol.</i>	0.32	0.03	9.3
<i>Transp. Res. Rec.</i>	0.01	0.00	8.0
<i>Transport Sci.</i>	0.47	0.31	>10
<i>Transportation</i>	0.32	0.00	7.6

**TABLE 3.** Impact Factors (IF) for Engineering Journals for 1999

Journal	IF
<i>Phys. Fluids</i>	1.63
<i>Biomaterials</i>	1.48
<i>Polymer</i>	1.34
<i>IEEE Trans. on Electron Devices</i>	1.78
<i>IEEE Trans. on Microwave Theory</i>	1.48
<i>AIChE J.</i>	1.42

may be relatively better than the work of the water resources engineers who publish in some of the lower-rated water journals, even though the water-related journals have quality indices that are higher than the better transportation journals. This is certainly an issue that must be addressed by civil engineering departments and colleges of engineering before, not after, they receive promotion and tenure packages. Should faculty be compared with their peers in their specialty or in their department? The ratings of journals from engineering disciplines outside of civil engineering can be challenging opponents to the ranking of civil engineering journals and thus push the bar even higher for civil engineering faculty. Table 3 gives the factors for a few of the journals in which those in other engineering disciplines publish. Of course, these other disciplines also have journals with lower IFs than those of Table 3.

## Measures of Research Impact

While IFs relate to journals, citation counts (<http://wos.isiglobalnet2.com>) are increasingly being used as yardsticks of the effect that a researcher is having on the research of others. The citation count of an article is the number of times the author's article has been cited by others. It supposedly reflects the extent to which the article influences the research of others. In a sense, it is the person's impact factor. Promotion committees generally discount self-citations or citations by coauthors. Also, citations for articles in conference proceedings, reports, and dissertations are given considerably less weight than those for archival, refereed journals.

How does a young faculty member achieve a respectable citation count in the short period of time before being reviewed for tenure? Obviously, publishing in journals with high Impact Factors will increase the likelihood of being cited. Second, publishing high quality papers is also a factor. The title of the paper should be designed to get a reader's attention, and the abstract should suggest that the paper includes important findings. Third, it helps to be publishing about a hot topic that is of broad interest. Publishing articles in narrow disciplines is unlikely to lead to many citations. Fourth, before sending your papers to journals for review, ask experienced colleagues to critically review your papers. This should increase the likelihood of having the papers accepted for publication, thus reducing the review time. An earlier publication date should increase the chance of the paper being cited. It is especially important to select colleagues who will do a thorough editing job.

## Departmental Strategy

In engineering colleges, the number of civil engineering faculty is often much lower than the number of faculty in the departments of electrical and mechanical engineering. Civil engineering faculty sizes are often small, yet have the responsibility for covering a wide array of disciplines. Therefore, they often hire young faculty in specialties that are not presently covered by their existing staff, and the newly hired tenure-track faculty may have limited opportunities to collaborate with other faculty in their department. This is unlike the larger engineering departments, where newly hired faculty often work within an established group. Working within a group increases the likelihood of getting published and subsequently having publications cited. This would place the applicant for promotion from a smaller department at a significant disadvantage when his or her promotion package is compared with those from the larger departments. The citation counts will generally be lower and the group rub-off factor may not be considered or even evident when just total counts are included in summaries for comparing all applicants.

What strategy can be adopted to ensure that citation numbers, IFs, and IIs do not unfairly influence promotion and tenure decisions both within civil engineering departments and within multidisciplinary colleges of engineering? First, departments and colleges must develop policies and guidelines that ensure fair assessments of numerical values on relative rather than absolute scales. While numbers such as citation counts and IFs can help remove some unwanted subjectivity from decisions, they can also introduce unreasonable expectations into the qualifications for promotion and create unfair imbalances in promotion and tenure decision-making. Second, faculty need to be made aware as to how these criteria will be weighted and used in the decision process. They should know years ahead, not during the time when they are preparing their promotion packages. Third, where journals of disciplines within a department typically have vastly different IFs and IIs, a department may need to develop a multiuniversity database of faculty at the same professorial level as the applicant so that comparisons within a discipline are truly made with peers. The database could include citation counts of faculty at the same professional level at peer institutions. This would enable both inter- and intrauniversity comparisons to be made. Departments could develop boilerplate documents that would be included with promotion packages. These documents would present the criteria used to judge the promotion records and values that are typical of those in the discipline. Such material may make the reviewers aware that it is appropriate to use different standards in judging the qualifications of tenure-track faculty seeking promotion.

With respect to the task of gaining tenure, the following are some considerations for tenure-track faculty with respect to citation counts and journal impact factors: First, do not develop a gap in your publication record during your first year or two in the tenure-track position, because this will limit the opportunity to have publications cited by others. This may result in a low citation count when the promotion package is reviewed for tenure. Gaps also suggest that the person has had difficulty developing new ideas. Second, network in the discipline where you are publishing. This generally requires attending at least one conference per year and hopefully serving on a professional society committee where you get to know others with similar interests. People who know you personally are more likely to cite your work. Third, distribute copies of your published papers to increase the likelihood that those with similar research interests will cite your work. Send reprints to those whose work you have referenced as well as others who have published in the discipline. Fourth, you should publish papers on which you are the sole author or with students to

show that you can publish without help from senior faculty. However, the papers of experienced researchers may be more likely to be cited, so also consider working with established faculty. A balance is needed. Fifth, avoid journals with low impact factors, as publishing in these tends to suggest less scholarly work—i.e., you are judged by the company that you keep. Promotion decisions are based as much on quality as they are on quantity. Sixth, make sure that you do not develop a downward temporal trend in the impact factors of journals in which you publish. If you publish in high-impact-factor journals as a graduate student and then publish in low-impact-factor journals when serving in a tenure track position, it may give the impression that the work with your research advisor was not reflective of your ability, only your advisor's ability. Seventh, citations of papers in conference proceedings, even when they are refereed proceedings, carry considerably less weight in the tenure review. It is better to save your best research papers for archival journals, as citations of these papers carry more weight.

Given the large number of applicants for each tenure-track position, colleges can raise the bar for awarding tenure and still find someone who can clear it. Also, the criteria that are used for judging the quality of a promotion-and-tenure package are changing. Objective criteria are replacing subjective assessments. Arguments can be made against these new criteria, but they probably are not going to disappear. Recognizing the importance of citation counts and journal impact factors early in one's pursuit of tenure should improve the likelihood of receiving tenure. Additionally, mentoring tenure-track faculty about these criteria and establishing department guidelines can increase a department's success rate in keeping qualified young faculty.

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