analysis

Time to convert to metrics

Subjective judgement remains the crucial arbiter of research, but the increasing drain on resources that it causes is forcing change. With more and more researchers making their work freely accessible online, the value and variety of objective metrics is still too little understood. Or so say **Tim Brody, Les Carr, Alma Swan** and **Stevan Harnad.**

What would Eugene Garfield, father of scientometrics and founder of the Institute of Scientific Information, have done if he had come of age in the online era rather than the paper era? There was a hint of what might have been in his keynote address last month at the 11th Annual Meeting of the International Society for Scientometrics and Informetrics in Madrid. The address was titled *From the Science of Science to Scientometrics: Visualizing the History of Science with HistCite Software*.

HistCite, developed by Garfield, uses the ISI citation database (Web of Science) to trace the lines of influence in research via citation and co-citation links. But, in the online age, citation links are just a special form of web link between a citing article and one or more cited articles. If he had been starting now, Garfield would not have been working on a proprietary database descended from the cut-and-paste paper era; he would have been developing open access scientometrics.

Two very important online developments are currently converging in the UK. First, authors are making their research free for all online ("open access", OA), to maximise its use and impact. And second, research funders are using metrics to rank and reward research contributions on the basis of online measures of their usefulness and impact. These were the subject of Stevan Harnad's keynote speech at the ISSI meeting, titled *Open Access Scientometrics and the UK Research Assessment Exercise*.

So far, about 15 per cent of researchers (across disciplines and around the world) make their published articles OA by uploading them on the web of their own accord, or 'self-archiving'. In the UK, however, 5 out of the 7 public research councils now officially require their grant recipients to self-archive their findings as a condition of funding, as do several private funders. Some UK universities are likewise beginning to require OA.

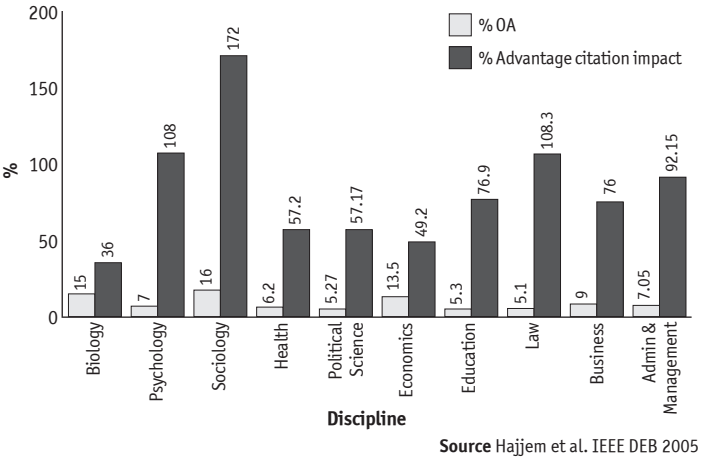
The UK is also unique in having a Dual Support System of research funding. Competitive research grants are just one component; the other is top-sliced funding, awarded to each UK university, department by department, based on how each department is ranked by discipline-based panels of reviewers who assess their research output. But this Research Assessment Exercise is costly and time-consuming. Furthermore, in almost every field tested, the panel rankings turned out to be highly correlated with metrics. So, the RAE is to be phased out and replaced by metrics. The fact that all of the submissions were already published, and hence peer-reviewed (and by the world's most qualified specialists in many cases), might have been a third reason for the change.

For a conversion to metrics, the only problem was determining which metrics to use. In some fields, there was a high correlation between the RAE rankings and prior grant income. But that correlation may well have been the result of an explicit bias by the panel, as the grant-income metric was already a visible component of the submission. Hence, relying only or mostly on that particular metric would be tantamount to jettisoning the Dual Support System altogether and simply putting a multiplier on the competitive-grant component.

In contrast, it was a surprising retrospective finding (based on post-RAE analyses in every discipline tested) that the departmental RAE rankings also correlated (highly, but not as highly as in the case of grant-income) with the citation counts for the total research output of each department. *Continued on page 18*

Citation advantage

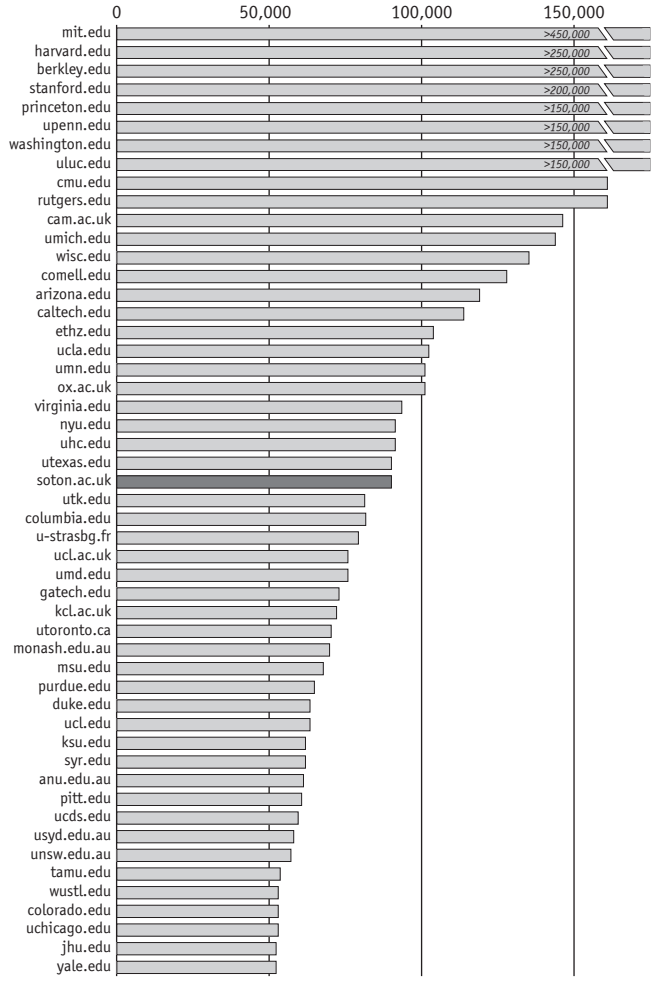
The small proportion of published articles that become freely available online (through open access, OA) are cited much more frequently than those that are not



Source Hajjem et al. IEEE DEB 2005

Visibly impressive

Free online access to its research output has given Southampton a high 'G-factor International University Ranking', which ranks universities according to the number of links to their websites (for the full chart, go to *http://www.universitymetrics.com/tiki-index.php?page=Top+300+Universities+Chart*).



Why would citation counts correlate highly with the panel's subjective evaluation of just four submitted publications? Each panel was trying to assess quality and importance. But that is also what fellow-researchers assess, in deciding what to risk building their own research upon. When researchers take up a piece of research, apply and build upon it, they also cite it. If we accept the panel rankings as valid, then the high correlation between citation counts and the panel rankings validates the citation metric as a faster, cheaper, proxy.

But are one-dimensional citation counts the best we can do, metrically? There are in fact many other research metrics waiting to be tested and validated: publication counts themselves are metrics. The number of years a researcher has been publishing is also potentially relevant and informative: high citations later in a career are perhaps less impressive than earlier, though that no doubt depends on the field. Total citations, average citations per year, co-citations, and download counts could all carry valid independent information. And so on…

Citation metrics today are based largely on journal articles citing journal articles—and mostly just those 8,000 journals that are indexed by ISI's Web of Science. That represents only a third (although probably the top third) of the total number of peer-reviewed journals published today, across all disciplines and all languages. Open access self-archiving can make the other two-thirds of journal articles linkable and countable too.

There are also many disciplines that are more book-based than journal-based, so book-citation metrics can now be collected as well.

Many other data could be counted as metrics too. Besides grant income and student counts, co-author counts may also have some significance and predictive value (positive or negative: they might just generate more spurious self-citations). It might make a difference in some fields whether their citations are from a small, closed circle of specialists, or broader, crossing subfields, fields, or even disciplines: an 'inbreeding/outbreeding' metric can be calculated. Patterns of change across time—'chronometrics'— may be important and informative in some fields. 'Semiometrics'can also be used to measure the degree of distance and overlap between different texts, from unrelated works on unrelated topics all the way to blatant plagiarism.

To allow research and researchers to reap the full benefits of the OA era the only thing still missing today is the approximately 85 per cent of current yearly research output that is still waiting to be self-archived. Research funders and institutions are beginning to require self-archiving. Study after study in field after field has demonstrated that self-archiving increases research usage and citations. And now the one last parallel panel/metrics RAE in 2008 will provide a unique natural test-bed for validating the rich new spectrum of Open Access metrics against the panel rankings.

At Southampton, the world's first departmental self-archiving mandate helped to demonstrate that OA enhances research impact. We also contributed to the movement to convert the RAE from panels to metrics.

If Eugene Garfield had come of age in the online era, he would be at Southampton designing the Open Access Scientometric Web.

More to say? Email comment@ResearchResearch.com

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