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ChE letters to the editor

To the Editor:

Professor Grossmann correctly points out errors that can occur when using citation statistics to compare graduate programs.^[1] However, the differences between the results of the two studies that Professor Grossman considered (the National Research Council report^[2] and Science Watch^[3]) should not be used as a reason for discounting the value of citation statistics. The major difference in the results likely arises from a difference in what the two studies were designed to measure, rather than from errors. The NRC study attempted to measure quality of *departments or programs*; the Science Watch study compared *institutions*. Therefore, the NRC study reported citations arising from a single program or department within a university while Science Watch reported citations from the entire university. Furthermore, while the NRC study attempted to be inclusive and cover all journals, the Science Watch study covered a very narrow range of journals. For example, the Science Watch list included no electrochemical journals, no materials journals other than polymers (and only three of those), and only one biotechnology journal.

As a consequence, even without errors of the types noted by Professor Grossmann, the citation counts will vary greatly

between the two studies. These differences could be in either direction. A university's chemical engineering activities would appear relatively weaker in the Science Watch study if it had major efforts in fields not included in the Science Watch journal list. Conversely, the chemical engineering activities would appear relatively stronger in Science Watch if the university had efforts in areas such as catalysis, surface chemistry, and combustion outside of the chemical engineering department. The Science Watch study is appropriate for comparing *universities* in the particular fields of applied chemistry and chemical engineering covered in the Science Watch database; it is not appropriate for comparing *chemical engineering departments* and should not be used for that purpose. The NRC study, which referred to programs rather than universities, has a more comprehensive database of publications and is appropriate for comparing chemical engineering programs.

Professor Grossmann is correct when he says we should use great care in interpreting countable indices such as citations and publications. However, it is possible to devise multiple, countable criteria that can give an alternative measure of graduate program quality.^[4] Engineers, in particular, should not be reluctant to use countable indices rather than "reputational rankings." The "reputational rankings" give little more than historical perspective and cannot accurately portray a dynamic field such as modern chemical engineering.

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To The Editor:

At the risk of fanning the flames of controversy concerning use of citation statistics in rankings of chemical engineering programs, I would like to add some comments engendered by the recent article by Ignacio Grossmann.^[1] I do so from the point of view of a department that has admittedly fared reasonably well by current measures, as indicated below.

Professor Grossmann has pointed out some real and potential flaws in the citation statistics compiled by ISI and frequently used by one group or another to establish relative rankings of research programs in many fields, including chemical engineering. Assuming that errors arising from misspellings will tend to be randomly distributed, I would like to focus on some pitfalls that are far more serious.

A key issue is the definition of those journals that constitute the domain of chemical engineering that is sampled for both papers and citations. A glimpse of the journals in question reveals that they are what might be termed classic journals. However, the research carried out by chemical engineers today covers a much broader spectrum of activity than was true as little as 20 years ago. A prime example is the whole biotechnology area, ranging from biomedical to biochemical engineering, which is the major focus of an increasing number of chemical engineers. Accordingly, many of those researchers publish their work in widely read but "non-traditional" journals that do not fit into the "classical chemical engineering basket" used by ISI and hence do not contribute to the statistics generated. Incidentally, citations for chemical engineering from particular institution are based on publications in those journals regardless of the home discipline of the authors within that institution.

Of secondary importance, in my opinion, is the limited time window that ISI uses in gathering data, namely papers published and citations made during a particular time period. A more serious error is misinterpretation of the data that is based on small samples.

The various sections of Table 1 indicate some data recently obtained from ISI. I am, of course, pleased to cite these data in view of Northwestern's favorable position, particularly over the long range as shown in Part D. However, I would like to draw attention also to Part C, for the years 1994-1998. Those data show Georgetown University and the University of Hawaii, neither of which has a chemical engineering program, ranked among the first ten institutions on the basis of a very small number of published papers (one, in the case of Georgetown).

What is one to conclude from study of these data? I suggest that there are many reasons to be wary of attaching too much significance to citation statistics as they are commonly presented. They represent nothing more nor less than what they are, namely the number of citations per paper published in a specific group of journals. As such, they may prove to be of value for comparisons of departments with similar ranges of programs and activities, but they can hardly be afforded more significance without a great deal of further elaboration and reworking. In the last analysis, such reworking may not provide enough additional insight to warrant the efforts involved. Furthermore, the data show that significant fluctuations can occur in any year or short time interval, with some institutions suddenly appearing high in the list or drifting out of the first ten altogether from time to time.

Finally, Professor Grossmann has suggested that the impact of papers as measured by numbers of citations varies considerably from one journal to the next. While that is clearly true, it should not be taken as a condemnation or a devaluation of those journals that have large readerships. Clearly, such journals may in fact be widely read and quoted

because of the quality and significance of the papers they publish, and faculty who are able to secure publication of their work in such journals may indeed have greater impact as a result.

(The assistance of Northwestern's Engineering and Science Librarian, Robert Michaelson, in gathering the data for Table 1 is acknowledged with thanks.)

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TABLE 1
Selected Citation Statistics, Chemical Engineering
(First 10 Institutions Ranked by
Number of Citations per Paper)

<i>Institution</i>	<i>Cites/Paper</i>	<i>Citations</i>	<i>Papers</i>
<u>Part A: Years 92-96 (5 years)</u>			
Northwestern	5.97	734	123
Univ Virginia	5.67	397	70
Univ Pittsburgh	5.01	606	121
Univ Calif Berkeley	4.95	727	147
Univ Pennsylvania	4.78	344	72
Univ Delaware	4.63	768	166
Caltech	4.47	635	142
Lehigh Univ	4.39	501	114
Univ Wisconsin Madison	4.15	564	136
Ohio State Univ	3.67	286	78
<u>Part B: Years 93-97 (5 years)</u>			
Northwestern	5.96	697	117
Caltech	5.39	625	116
Univ Pittsburgh	5.12	681	133
Univ Calif Berkeley	4.55	692	152
Lehigh Univ	4.47	451	101
Univ Wisconsin Madison	4.26	558	131
Univ Delaware	4.18	703	168
SUNY Buffalo	3.94	512	130
Univ Minnesota	3.92	658	168
Univ Texas Austin	3.46	564	163
<u>Part C: Years 94-98 (5 years)</u>			
Georgetown	23	23	1
Caltech	8.7	531	61
Univ Hawaii	8.13	130	16
Northwestern	6.49	733	113
Univ Virginia	6.15	400	65
Univ Connecticut	5.77	202	35
Univ Colorado	5.66	487	86
Univ Penn	5.48	296	54
Univ So. Calif	5.42	195	36
Univ Pittsburgh	5.4	680	126
<u>Part D: Years 81-97 (17 years)</u>			
Univ Calif Berkeley	16.07	9241	575
Univ Wisconsin Madison	14.48	6663	460
MIT	14.15	7174	507
Northwestern	13.81	5484	397