EVALUATION OF RECENT SCIENTIFIC RESEARCH OUTPUT BY BIBLIOMETRIC METHOD

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ABSTRACT

This paper describes a new method of evaluation of scientific output by laboratories engaged in diverse fields of research. The method used is aiming at evaluating those outputs which are quiet recent and not amenable to citation analysis. For the purpose of analysis, impact factor of journals in which papers are published are considered. A method for normalisation of impact factor of journals has been described and, normalised impact factors have also been used It is found that normalised impact factor tends to show better results compared to simple impact factor. The analysis helps us to generate numerous performance indicators such as average impact factor and normalised impact factor for each laboratory and the research complex such as the Council of Scientific and Industrial Research (CSIR) as a whole; average impact factor and normalised impact factor for each scientist of a laboratory and the research complex; spectral distribution of papers falling within various ranges of impact factors and normalised impact factors. By comparing the performances over several years the trend of research activity of each laboratory can also be obtained.

RESUME

Cet article décrit une nouvelle méthode d'évaluation de la production scientifique de laboratoires actifs dans des domaines de recherche variés. La méthode utilisée a pour but d'évaluer les produits scientifiques récents pour lesquels les analyses de citation se révèleraient inappropriées. Il s'agit d'utiliser le 'facteur d'impact' des revues dans lesquelles les travaux sont publiés. Des facteurs d'impact normalisés ont été mis au point et utilisés. Ces derniers permettent d'obtenir de meilleurs résultats que le facteur d'impact simple. Ce travail a permis de générer de nombreux indicateurs de performance tels que le facteur d'impact moyen et le facteur d'impact normalisé pour chaque laboratoire et pour l'ensemble du Conseil National de la Recherche Scientifique et Industrielle (CSIR); un facteur d'impact moyen et normalisé pour chaque chercheur; une distribution spectrale d'articles scientifiques en fonction de leurs facteurs d'impact simple et normalisé. En comparant les performances sur une période de plusieurs années, la tendance de l'activité scientifique de chaque laboratoire peut également être obtenue.

INTRODUCTION

With the appearance of Science Citation Index (SCI) in 1963, it became possible to judge by the citation scenario, the impact a paper has made in the world. The number of citations received by a paper was more or less clearly depicting its impact. In addition the total impact of the contribution of a scientist was also becoming available from the aforesaid publication purely through the citation count of his papers. It is at this time, 1968 to be precise, when SCI was in its formative stage. Dr. Eugene Garfield, the originator of the publication, drew out a list of 50 most cited scientists of the world (Table 1) using SCI database of 1967 from among about a million scientists and predicted that many a scientist appearing in the list would be crowned with Nobel Prize in future [1].

It is rather amazing that in the year 1969 itself Dr. Garfield's prediction came [illegible]

Scientific and Industrial Research, India) laboratories numbering about 40 to generate indicators which might be useful for decision making and other purposes.

After considering various probables, it was decided that impact factors of periodicals in which CSIR papers have been published can be used in place of citations for our analysis, since impact factor shows the standing of a periodical in the world which is available from the Journal Citation Report (JCR), an associate publication of SCI database [2]. The impact factor is a measure of the frequency with which the 'average article' in a journal has been cited in a particular year. The JCR impact factor is basically a ratio between citations and citable items published. Thus, the 1986 impact factor of journal X would be calculated by dividing the number of all the SCI, SSCI and A&HCI source journals' 1986 citations of articles journal X published in 1984 and 1985 by the total number of source items it published in 1984 and 1985. For example, Nature published 1,192 and 1,176 citable items in 1984 and 1985 respectively and these items were cited 20,173 and 15,943 times respectively in 1986. Therefore the 1986 impact factor (2) of Nature is given by :

$$If = \frac{20,173 + 15,943}{1,192 + 1,176} = 15,525$$

Our basic premise was that the higher the impact factor of a journal the better will be its quality. Of course, this premise may not hold good where the impact factors of journals are very close to one another. As a corollary to our premise it was assumed that a paper published in a high-impact-factor journal will be better in quality than the one published in a low-impact- factor journal. This premise

excluded. Papers published in monographs, patents, research reports were also not considered.

Once we have finally selected the articles for our analysis, we started assigning each paper its impact factor, i.e. the impact factor of the joural in which the paper has been published. It is to be noted that Journal Citation Report is a yearly publication, and it provides impact factors of some 4000 journals selected

responsible for this: first, the engineering laboratories published less number of papers, compared to biomedical and other laboratories, and second, engineering science periodicals, by and large were having very low impact factors, compared to those of the biomedical periodicals. For example, the top research journal on aerospace engineering called AIAA Journal was having If of .520 in 1986, when the top journal on general medicine called New England Journal of Medicine was having If of 17.752. In order to resolve this anomaly we had to think of normalised impact factor (NIf).

In JCR, categorywise list of journals ranked by impact factor is available. The ranked list of journals under each category includes both review and research journals. The If of review periodicals are generally high, sometimes very high, compared to research periodicals. For example, in the subject category Biochemistry and Molecular Biology, the 1988 If of Annual Review of

So, the value of X for this subject category is

Average Impact Factor and Average Normalised Impact Factor of a Scientist

This helps to generate indicators as to the productivity per scientist of a laboratory or a group of laboratories pertaining to a broad discipline like Chemical Sciences or Life Sciences, or a big research complex like CSIR.

Total Impact Factor of all laboratories and their average Impact Factor

These help us to study the trend as to the performance of the laboratories taken together over a period of years. It may be pointed out that the average impact factor and normalised impact factor of CSIR laboratories as a whole remained more or less constant at 0.6 and 2 for three years since 1986 .

Papers above CSIR average

Laboratorywise distribution of papers above CSIR average impact factor and normalised impact factor (Fig.8 & 9) provides a good deal of indicators about the papers published in good quality journals. From the graph, one can also have some idea as to the standard of work being done in various laboratories.

Spectral Distribution

Spectral distribution shows the concentration of papers at various impact factor and normalised impact factor ranges (Fig.10 & 11).

CONCLUSION

The CSIR Research Output is being analysed since 1987 following the method described above. This method of analysis has attracted the attention of many scientists of the country, including those in the top brackets, and has earned a great deal of appreciation even from scientists like the Director General of CSIR, and many directors of CSIR laboratories. However, it has attracted criticism as well mainly from the group of engineering laboratories, in as much as engineering periodicals are very sparingly covered by SCI. For some branches

References

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2. Journal Citation Report Philadelphia, Pa: Institute for Scientific Information, 1975.

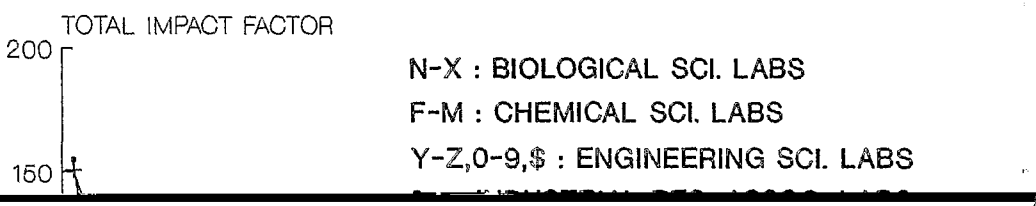
3. Sen B K, Karanjai A, Munshi J M: A method for determining the impact factor of a non-SCI journal. J DOC 89, 45(2), 139-41, 1989.

4. Council of Scientific and Industrial Research (CSIR), New Delhi: Research Output 1987: Bibliometric analysis of research papers. New Delhi: the author, 1988.

5. Council of Scientific and Industrial Research (CSIR), Research Output 1988 - a Bibliometric analysis. New Delhi: the author, 1989.

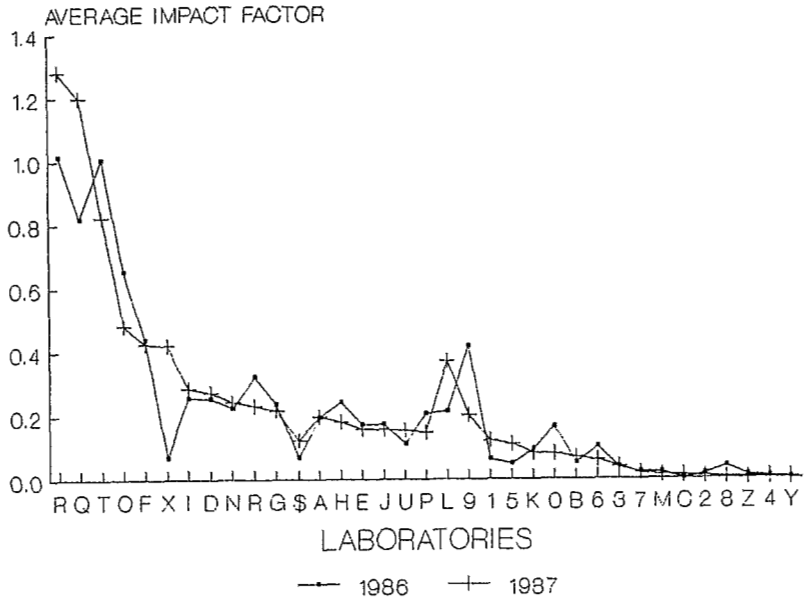
Annex

Figure-1



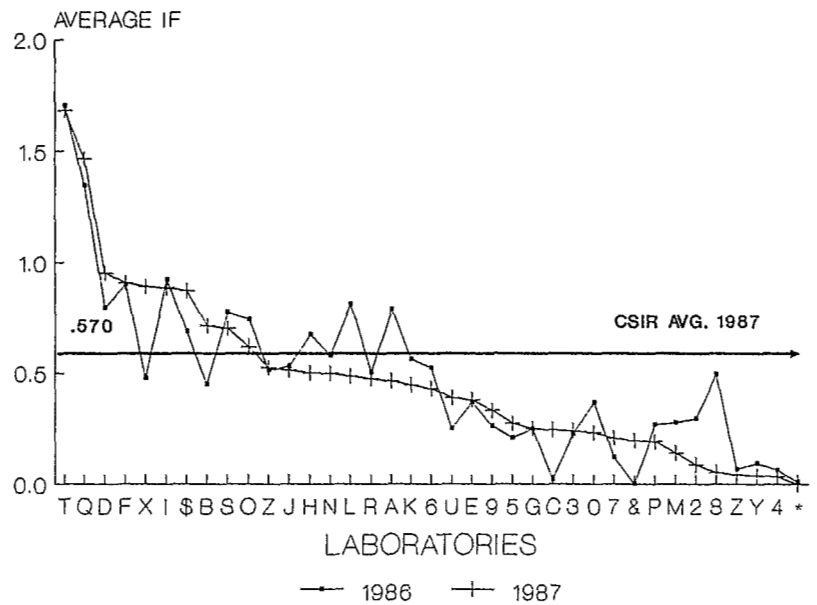
AVERAGE IF/SCIENTIST 1986, 1987

Figure-3

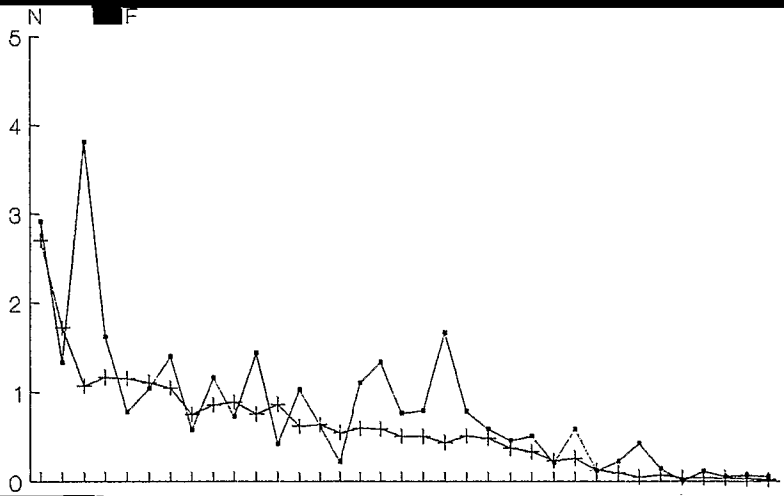


AVERAGE IF/PAPER 1986, 1987

Figure-2



AVERAGE NIF/SCIENTIST 1986–1987



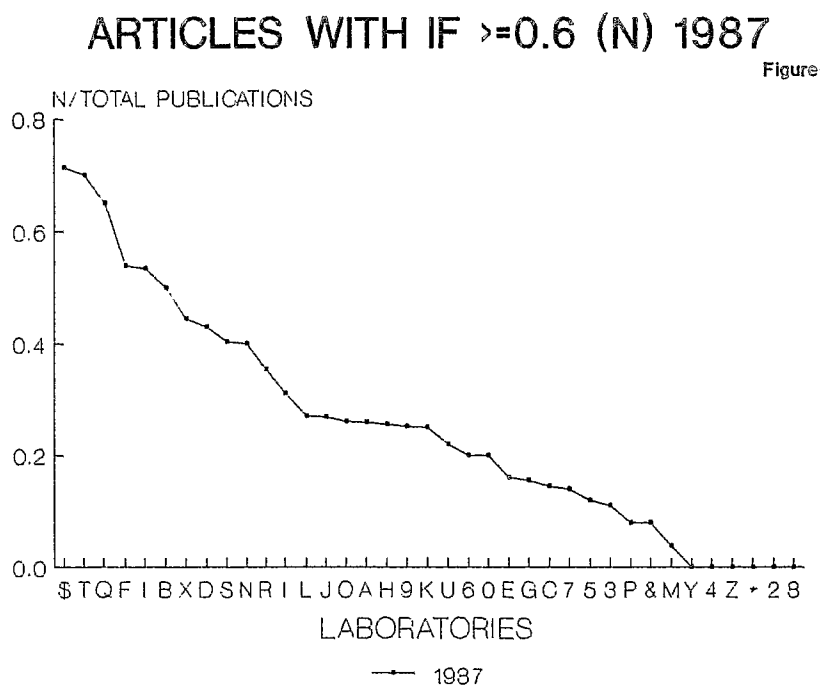


Figure-8

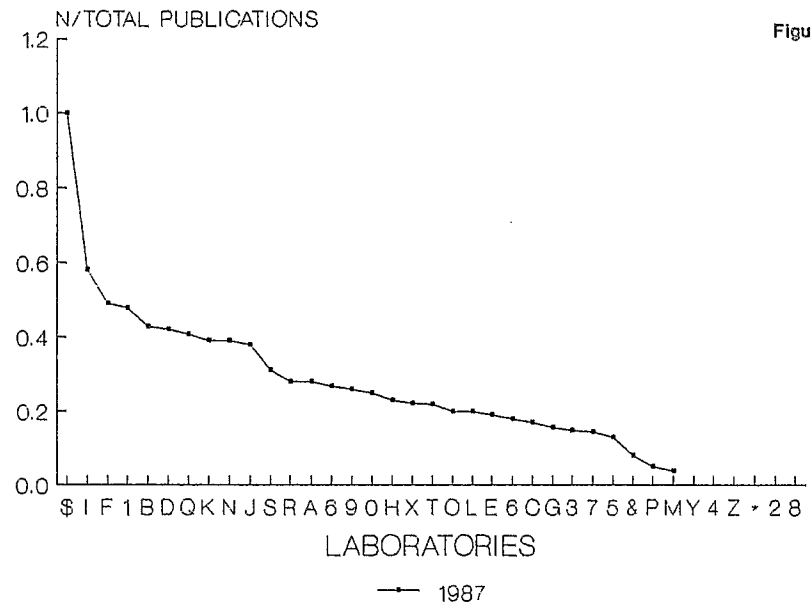
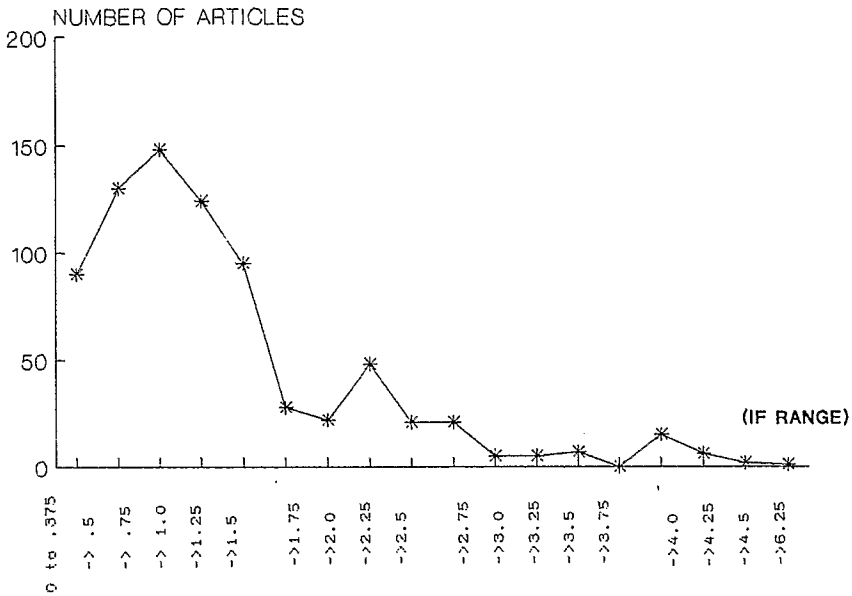


Figure-9

SPECTRAL DISTRIBUTION OF ARTICLES - 1987 (IF RANGE)

Figure-10



SPECTRAL DISTRIBUTION OF ARTICLES - 1987 (NIF RANGE)

Figure-11