The Development and Use of Research Performance Indicators for UK Universities - An Overview

Hans-Dieter Daniel

1. Introduction

The 1980's have proved a period of unprecedented stress and change in UK science. The whole system of higher education is under pressure to make the research that is carried out in universities and polytechnics more effective and efficient, more competitive internationally, and more responsive to national economic and social needs. As a result, the internal arrangements of individual institutions, and their relationship with central Government and with industry, are being radically restructured. Professor Ziman, Director of the Science Policy Support Group (London), reviews (in this issue) the institutional restructuring of academic science in the United Kingdom. He drews attention to several key issues that would have to be dealt with in the next few years. Professor Ziman outlines a 'scenario' set out in the SPSG paper "Restructuring Academic Science" showing how the British higher education system might look in the mid 1990's.

Higher-education institutions in the United Kingdom currently face considerable financial pressure. Several decades of budgetary growth have given way to level funding or even cuts (cf. Ziman, 1987). One response, at both national and institutional level, has been to try to adopt a policy of greater selectivity and concentration (cf. Jackson, 1989). From this springs the need for systematic methods to identify areas of comparative strength and weakness - and hence for performance indicators. Such indicators are also a response to demands for greater accountability and more effective management of the public funds invested in universities, i. e. for better 'value for (the taxpayers') money'.

2. Structure of Support for Research at UK Universities

Universities in the United Kingdom rely on Government and private funding for their research. The Government funding comes through three main channels:

1. Department of Education and Science (DES) funding through the "Science Vote", allocated among the Research Councils following advice by the Advisory Board for the Research Councils (ABRC) to DES, and then distributed to universities and other research institutions by the Research Councils;

2. Department of Education and Science funding, distributed through the Universities Funding Council (UFC);

3. Commissions, contracts and grant-aided support from Government departments.

British universities have been subject to a long period of level funding in which overall government support for civil research and development fell from 0.70 per cent of Gross Domestic Product in 1982 to 0.58 per cent in 1987 (cf. Irvine, Martin & Isard, 1990). The implicit promise made by the Government was that the budget for academic research would ultimately rise when the British economy had been revitalized, but only if the universities were first able to demonstrate that they were using existing public resources effectively. The effect has been to precipitate fundamental changes in the way university research is funded.

At the end of the 1980s the income of British universities is very different from that at the beginning of the 1980s. Table 1 shows, for example, the income summary of the University of Salford for 1981 and 1989 (Source: personal communication by Professor J. M. Ashworth, former Vice-Chancellor of the University of Salford, now Director of the London School of Economics and Political Science).

Table 1
Income Summary of the University of Salford
(1989 compared with 1981)

Source of Income	Income (At 1989 prices) 1989 £'000	1981 £'000	% Change
Direct Funds (i.e. UGC and Home Fees)	19,494	29,676	-34
Self Supporting Fees	2,696	1,655	63
Research Grants and Contracts	3,556	1,871	90
Consultancies	1,248	276	352
Self-financing Courses and Conferences	1,677	132	1,170
Interest	742	745	<1
Company Income	7,140	881	710
Total	36,553	35,296	4

The University of Salford suffered a cut of 34 per cent in direct Government funds between 1981 and 1989. During the same period the income of the consultancy company [Salford University Business Services Ltd] which is wholly owned by the University and of a number of other activities has greatly increased. The income of all British universities analysed by source of income is shown in Table 2.

Table 2
Recurrent and Non-Recurrent Income of British Universities (£ thousands)
Analysed by source (1978-79 to 1988-89)

Source of Income	1978-79	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
Total recurrent income	1003,373	1982,782	2119,647	2295,133	2483,813	2707,799	3081,037
Total general income	848,852	1597,319	1667,601	1757,977	1851,299	1999,889	2239,954
% of total recurrent income	*84.6*	*80.6*	*78.7*	*76.6*	*74.5*	*73.9*	*72.7*
Exchequer grants	626,845	1225,251	1258,008	1311,991	1367,047	1482,329	1619,570
% of total recurrent income	*62.5*	*61.8*	*59.3*	*57.2*	*55.0*	*54.7*	*52.6*
Fees and support grants	175,733	260,575	282,536	312,802	339,868	364,446	398,585
% of total recurrent income	*17.5*	*13.1*	*13.3*	*13.6*	*13.7*	*13.5*	*12.9*
Endowments, donations and subventions	9,836	22,855	22,055	28,237	33,286	36,430	47,036
% of total recurrent income	*1.0*	*1.2*	*1.0*	*1.2*	*1.3*	*1.3*	*1.5*
Other general recurrent income	36,438	88,638	105,002	104,947	111,098	116,684	174,762
% of total recurrent income	*3.6*	*4.5*	*5.0*	*4.6*	*4.5*	*4.3*	*5.7*

(continued on next page)

Table 2
(continued from previous page)

Source of Income	1978-79	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
Total specific income	**154,521**	**385,463**	**452,048**	**537,156**	**632,514**	**707,910**	**841,083**
% of total recurrent income	*15.4*	*19.4*	*21.3*	*23.4*	*25.5*	*26.1*	*27.3*
Research grants and contracts	127,100	301,815	348,990	410,084	481,276	529,725	628,509
% of total recurrent income	*12.7*	*15.2*	*16.5*	*17.9*	*19.4*	*19.6*	*20.4*
Other services rendered	27,421	83,648	103,058	127,071	151,238	178,185	212,574
% of total recurrent income	*2.7*	*4.2*	*4.9*	*5.5*	*6.1*	*6.6*	*6.9*
Total non-recurrent exchequer grants	**73,036**	**100,452**	**112,737**	**111,353**	**142,922**	**120,607**	**152,644**
Equipment and furniture	42,177	89,600	91,740	94,586	119,060	102,685	121,413
Building works	12,961	6,086	7,234	7,616	12,320	11,445	10340
Purchase of sites/properties	1,090	198	322	176	320	682	13
Professional fees	2,406	1,262	2,493	1,866	2,869	1,661	3,147
Teaching hospitals	14,402	9,305	10,947	7,110	8,353	4,134	17,731

Source: Universities Statistical Record 1988/89 (volume on university finances)

3. Government Funding and Evaluation Procedures

The United Kingdom is a good example of "evaluation pluralism" where different evaluation procedures reflect different types and purposes of research. The ABRC, for example, advises the Secretary of State for Education and Science on what the "Science Vote" should be and, once it is determined, how it should be distributed between the Research Councils. It advises on the priority which should be given to different fields of science and to the various components of science funding - research programmes, interdisciplinary research centres, manpower and training, equipment and facilities. It also commissions studies relevant to its role in advising on science policy issues, including the use of performance indicators and bibliometric techniques in the assessment of scientific programmes and policies (cf., for example, Department of Education and Science, 1986).

The Research Councils are independent bodies, responsible for determining their own priorities and for evaluating their research programmes and other activities. The peer review system, by which research proposals and research outputs are subjected to the scrutiny of the academic peer group, has been and remains an important element in the British scientific tradition. It has been complemented increasingly by the use of output and performance indicators and by other criteria, such as contribution to economic and social needs, as well as scientific excellence.

The University Grants Committee (UGC), established in 1919, was the intermediary body between the Government and the fifty or so universities in Britain. It was traditionally the main source of advice to ministers on matters of policy regarding universities, as well as being responsible for the distribution of Government funds to them. The UGC was replaced by the UFC in 1989.

The UFC decides on the levels of the block grants the universities receive from the Department of Education and Science. In 1986 the predecessor body to the UFC, the UGC, instituted a funding mechanism whereby both teaching-based criteria and research-based criteria are used in determining the value of block grants. On the research side, a university's achievement in winning Research Council and other grants, publication record and success in attracting industrial and commercial support for research, all contribute to the formulation of future block grants. In addition the UGC undertook a series of national subject reviews which took departmental publication records into account (cf. Aubert, 1989, pp. 150-151).

4. The UGC/UFC's Research Assessment Exercises

As implementation of cuts began (the British Government introduced cuts of 15 per cent across the university system in 1981), the UGC developed a strong interest in identifying successful university departments within different areas of research, and concentrating funds for infrastructural support accordingly. The first cuts in 1981, therefore, were not shared out equally amongst institutions. Some universities were hit much harder than others. No reason was given by the UGC for the extent of these differences. The academic community initially adopted a defensive posture and questioned the mechanism by which the UGC framed its recommendations for individual universities.

When the UGC under a new chairman, Sir Peter Swinnerton-Dyer, formalized the policy of selectivity in 1985, it attempted to make the reasons for the differential treatment between departments and universities more transparent than was the case in the early 1980's. The first formalized 'selectivity exercise', which involved ranking the performance of departments across the country was carried out in 1986. The second was implemented in 1989. The UGC's 1986 research-ranking exercise has stimulated much activity in the construction, measurement and use of research performance indicators. Phillimore (1989) distinguished four aspects of performance (output, input, quality, utility) and ten different research performance indicators used in the UGC debate (cf. Table 3).

It should be apparent from Table 3 that no simple, objective measure of research performance exists. The UFC, therefore, used a wide array of measures in its 1989 research assessment exercise. Table 4 shows the 1989 research rankings of UK universities. It should be mentioned, however, that the UFC itself did not compare entire universities. The aggregation of departmental scores to an overall assessment of universities was carried out by the press (e. g. Financial Times, The Guardian). The first column of Table 4 shows the number of departments given the top ranking of 5, which means work of international excellence in some areas plus national excellence in all others.

Table 3
Aspects and indicators of research performance used in the UGC debate

Aspect of "performance"	Relevant indicator	Inadequacies and complications of each indicator
Output	Publications	- quantity not necessarily related to impact or quality (see indicators below) - which publications? What "weighting" to apply to each?
Impact	Citations	- self-citations, "halo" effect - negative citations ("garbage-in, garbage-out" effect) - "weighting" problems (similar to publications - "not all journals (or citations) are equal") - expensive and time-consuming to collect
Quality	Research Council grants	- an input, rather than an output indicator - reflects production costs, not importance or quality of the research - may reflect non-research factors (e.g., lobbying ability, political favouritism, "old-boy networks")
	Research studentships	- may reflect teaching, rather than research, quality - may be a function of funding structures
	Awards, prizes, honours, etc.	- reflects past achievements - may also reflect non-research factors (see Research Council grants)

(continued on next page)

Table 3
(continued from previous page)

Aspect of "performance"	Relevant indicator	Inadequacies and complications of each indicator
Utility	Committee memberships, journal editorships	- reflects past eminence - may reflect administrative, not research, ability
	Peer judgement, "reputation"	- may be misinformed - may be out of date - may be unrepresentative
	External income	- different subjects have different opportunities to earn outside income - may reflect locational and/or political factors
	Patents, licenses	- as for external income (above) - may reflect the bargaining ability or intellectual property policy of the university administration as much as research quality or utility
	Contract / external staff	- may reflect staff restrictions, rather than a desire for utility
Source: Phillimore (1989, p. 263)		

Table 4
Research Rankings of UK Universities

University	Number of departments with Top score	Bottom score	Average
Cambridge	34	0	4.7
Imperial	13	0	4.6
Oxford	32	0	4.6
UC London	20	0	4.3
Warwick	11	0	4.1
LSE	7	0	4.0
Bristol	10	2	3.8
UMIST	3	0	3.7
York	3	0	3.7
Manchester	3	0	3.6
Essex	5	0	3.4
Sussex	1	2	3.4
Edinburgh	7	5	3.3
Liverpool	5	3	3.3
Southampton	5	2	3.3
Durham	3	3	3.2
Lancaster	3	1	3.2
Nottingham	7	5	3.2
QMC London	1	1	3.2
Sheffield	5	2	3.2
Birmingham	3	4	3.1
East Anglia	2	1	3.1
Leeds	3	6	3.1
Newcastle	2	1	3.1
Birkbeck	2	2	3.0
King's London	6	3	3.0
Surrey	1	0	3.0
Cardiff	2	4	2.9
Exeter	1	1	2.9
Glasgow	3	6	2.9
Reading	1	1	2.9
St. Andrew's	1	1	2.9
Aberystwyth	0	1	2.8
Bath	0	1	2.8
Leicester	1	2	2.8
Swansea	1	3	2.8

(continued on next page)

Table 4
(continued from previous page)

University	Number of departments with Top score	Bottom score	Average
Aberdeen	1	4	2.7
Kent	2	3	2.7
Aston	1	2	2.6
Loughborough	5	3	2.6
Bangor	0	3	2.5
Dundee	1	7	2.5
Hull	0	1	2.5
Royal Holloway	1	4	2.5
Bradford	0	1	2.4
Strathclyde	2	10	2.4
Belfast	1	11	2.3
Heriot Watt	5	4	2.3
Stirling	0	5	2.2
Brunel	0	4	2.1
Ulster	0	5	2.1
City	0	5	2.0
Keele	0	8	2.0
Salford	0	4	2.0

Source: Financial Times, August 26, 1989

The second column shows the number of departments given the bottom ranking of 1, which means work of national excellence in virtually no areas. The final column is each university's average ranking across all the departmental groupings, known as 'cost centres', used by the UFC to distribute its research money. The results suggest that research excellence is very unevenly distributed among British universities: at one extreme, Cambridge and Oxford each have over 30 departments rated 5 (highest score) and none rated 1 (lowest score); at the other are several universities with only one or no department given the top score of 5 (i. e. work of international excellence

in some areas plus national excellence in all others). The 1986 und 1989 research assessment exercises are described in more detail by Jones and Sizer (in this issue).[1]

5. Differentiation between Institutions or within Disciplines?

The British university community has now mostly accepted the need for selectivity and concentration. The Advisory Board for the Research Councils (ABRC) and the UGC have proposed alternative strategies to bring about appropriate concentration of research activity. In a discussion document, the ABRC proposed differentiation between three types of institutions: Type R (with substantial research activity across all fields), Type X (with substantial research activity in particular fields), and Type T (pursuing the research and scholarship necessary to support teaching but without advanced research facilities). The UGC/UFC strategy, on the other hand, focused on selectivity at the level of departments or cost centres.

The British university community seems at present to have come out against the ABRC proposal for three categories of higher education institutions and claims that it does not reflect the highly distributed nature of research excellence across the academic system (cf. Phillips, 1988).

6. Subject Reviews

Departmental reputation may be earned in different ways. Some departments may be outstanding for their undergraduate teaching, some for their international reputation in research, some for their concentration on some aspects of applied research making both the staff and their students of special value to a particular industry. The joint working group of the Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom (CVCP) and the UGC has, therefore, stressed that it is important for the health of a subject that this diversity be retained.

---

[1] Peter K. Jones is the UFC Executive responsible for the overall coordination of the Exercise. Sizer draws upon his own experiences as a member of the UGC and Chairman of the Business and Management Studies Sub-Committee from 1984 to its abolition on March 1989, as Chairman of the UFC's Business and Management Studies Advisory Group for the 1989 Exercise and as a member of the CVCP/UFC Research Performance Indicators Group.

The selectivity exercises take place on five-yearly cycles and are primarily concerned with performance evaluation. As such, they represent a tactical device designed to help concentrate resources on the most productive departments and to stimulate competition and diversity. However, these exercises are of less value for making more specific decisions on the future of individual disciplines. Here, many other factors must be considered by specialist review committees, convened to undertake the evaluation (Anderson, 1989).

Oxburgh (1987), the chairman of the Earth Science Review Committee, pointed out that subject reviews should take into account a variety of considerations including those put forward in the statement of performance indicators of the joint CVCP/UGC working group in 1986.

7. University Management Statistics and Performance Indicators

The CVCP and the UGC/UFC have been publishing performance indicators for four years now. Table 5 shows the contents of the 1990 edition of the "University management statistics and performance indicators". One of the purposes of these management statistics is to facilitate meaningful comparisons of activity both within individual institutions and between them.

Table 5
University Management Statistics and
Performance Indicators in the UK

Expenditure in Academic Departments (by Cost Centre)
- -FTE* Academic Staff
- -Expenditure per FTE Student
- -Expenditure per FTE academic staff
- -Expenditure on support staff per FTE academic staff
- -Expenditure on equipment per FTE academic staff
- -Research income per FTE academic staff

Students and Staff (by Cost Centre)
- -FTE Student Load
- -Research postgraduates as a % of FTE students
- -Taught postgraduates as a % of FTE students
- -All postgraduates as a % of FTE students
- -Ratio of FTE students of FTE teaching staff

Expenditure on Central Administration
- -Central administrative expenditure as a % of grand total expenditure
- -Pay expenditure as a % of central administrative expenditure
- -Central administrative expenditure per FTE student
- -Central administrative expenditure per FTE academic staff

Expenditure on Libraries
- -Library expenditure as a % of total general expenditure
- -Publications expenditure as a % of library expenditure
- -Library pay expenditure as a % of library expenditure
- -Library expenditure per FTE student
- -Library expenditure per FTE academic staff
- -Expenditure on books per FTE student
- -Expenditure on periodicals per FTE student

Expenditure on Computer Services
- -Computer services expenditure as a % of total general expenditure
- -Computer services pay expenditure as a % of Computer services expenditure
- -Computer services expenditure per FTE student
- -Computer services expenditure per FTE academic staff

Expenditure on Premises
- -Total premises expenditure as a % of total general expenditure
- -Premises pay expenditure as a % of premises expenditure
- -Heat, water and electricity expenditure as a % of total general expenditure
- -Cleaning and custodial services expenditure as a % of total general expenditure
- -Repairs and maintenance as a % of total general expenditure

(continued on next page)

Table 5
(continued from previous page)

- -Telephone expenditure as a % of total general expenditure
- -Total premises expenditure per FTE student
- -Premises pay expenditure per FTE student
- -Heat, water and electricity expenditure per FTE Student
- -Cleaning and custodial services per FTE student
- -Repairs and maintenance expenditure per FTE student
- -Telephone expenditure per FTE student

Expenditure on Careers Services and Student Organisations

- -Careers Services expenditure per FTE student
- -Grants to student organisations per FTE student

First Destinations of First Degree Graduates by Subject

- -Destinations as at 31 December after graduation, UK totals by academic staff

First Destinations of First Degree Graduates by University

- -Total graduates with known destinations
- -Graduates with destination "unemployed or short-term"
- -Predicted value of graduates with destination "unemployed or short-term"

First Destinations: National proportion of "unemployed or short-term" by Subject, 1987 to 1989

Undergraduate Success (by academic subject group)

- -Number of successful leavers
- -Success as % of those ending their studies
- -Proportions on three and four year courses
- -Terms of attendance per success
- -Terms of attendance per success relative to expected value

Qualifications of Full-Time Undergraduate Entrants, 1987 to 1989 (by academic subject group)

- -Entrants with 3 or more A-Levels, numbers
- -Entrants with 3 or more A-Levels, scores
- -Entrants with 5 or more Scottish Highers, numbers
- -Entrants with 5 or more Scottish Highers, scores
- -Entrants with other qualifications

Source: Committee of Vice-Chancellors and Principals and Universities Funding Council, 1990

* FTE = Full-Time Equivalent

8. Bibliometric Profiles for UK University Departments

The CVCP/UGC saw a great advantage in having complete publication profiles for all university departments. In 1988 it was decided to explore further the possibilities and limitations of large-scale bibliometric analysis by establishing, within the CVCP/UGC Performance Indicators Steering Committee, an expert Sub-Committee on Research Indicators (cf. Anderson, 1989). The Research Indicators Sub-Committee (RISC) brings together science policy experts and UFC officials. The remit of RISC is to establish a model for a more comprehensive database on all UK university publications. It is testing a methodology for counting the research publication output of university staff. It is intended to begin the annual collection of data from the beginning of calendar year 1991 and to publish some of the data as soon thereafter as possible. Universities are encouraged to develop appropriate local databases of research output, which can be readily called upon in future (cf. CVCP/UFC, 1990).

There have been other efforts to construct bibliometric profiles for university departments using commercially available databases (cf. Carpenter et al., 1988; Irvine, 1989). In addition, a major programme is being undertaken at the Science Policy Research Unit at the University of Sussex funded jointly by the Economic and Social Research Council and the Advisory Board for the Research Councils (cf. Martin, in this issue). Martin's study aims to develop a database (derived from the Science Citation Index) on publication and citation indicators for all UK higher education institutions over the period 1981-90, as well as exploring a range of other possible performance indicators.

A somewhat different methodology has been employed by Collins at the Royal Society's Science and Engineering Policy Studies Unit (SEPSU) in a confidential bibliometric assessment of university earth science departments (cf. Oxburgh, 1987). Collins asked academics to supply their own publication and citation data rather than relying on the computerized analysis of the Science Citation Index.

9. Reputational Rankings of Universities

The reputational ranking of universities by academics is one of the oldest and best-known assessment methods. Reputational rankings are based on the opinions of experts - deans, departmental chairpersons, and distinguished scholars in an academic discipline or professional field - who rank departments in order of their faculties' reputation for research or teaching. The

first reputational ranking of university departments was carried out in the United States as far back as 1924 (Hughes, 1925). The most recent reputational survey, which used quality ratings along with 14 other measures, was published by the U. S. National Academy of Sciences in 1982 (cf. Jones, Lindzey & Coggeshall, 1982).

Reputational rankings have been criticized often and for many reasons (Dolan, 1976). First, the overall reputation of a university may influence, for better or worse, raters' assessment of the particular department they are being asked to rank. Second, smallness of institution or subject reduce visibility, while largeness may exaggerate fame. Third, smallness of sample and a low response rate increase the risk of measurement error. Fourth, reputational rankings often lag several years behind "reality". Fifth, scholars from the nation's leading universities serve in disproportionately large numbers as raters, and they tend to rank high those departments of the same type, and with the same emphases, as their own universities. In a comprehensive survey of academic quality rankings of American colleges and universities Webster (1986) concludes that reputational rankings are the worst device for comparing the quality of institutions - except for all the others.

Halsey, professor of Social and Administrative Studies at the University of Oxford, reports (in this issue) on reputational surveys of British academics carried out in 1976 and 1989. The scholars were asked "Where are the best three departments in your subject, whether at universities or polytechnics?". The findings of the 1989 survey can be used to assess the validity of the UFC's 1989 research assessment exercise. All in all, the hierarchical character of the British university system comes out very clearly, with Oxford and Cambridge and the major London colleges being particularly prominent. But, below these peaks, further differentiation is hazardous.

10. The Impact of the Research Assessment Exercises on British Universities

Sir William Taylor, Vice-Chancellor of the University of Hull, comments from the universities' point of view on the UFC's research assessment exercise. In the first part of the paper, the author sketches the social, political, economic and institutional context in which research assessment exercises take place in the UK. The impact of the 1985 and 1989 research assessment exercises on the University of Hull is described in the second part of the paper. Examples are given of how research selectivity has influenced distribution of resources within the University of Hull. The overall effect of the research assessment exercises has been to focus and concentrate resources

upon those areas in which the staff concerned are strongest and best able to advance and apply their specialist knowledge. However, the university is not just a centre for research. Performance evaluations should, therefore, place stress on the monitoring of teaching, culture and consultancy as well.

11. Conclusions

In sum, research performance evaluation poses many problems for those involved in assessing the effectiveness of higher education institutions. The UFC's 1989 research assessment exercise, however, cannot easily be dismissed as biased and unsound. The UFC certainly has carried out one of the best evaluation studies ever done.

In his review paper on the UGC's 1986 research assessment exercise Phillimore (1989) found it difficult not to feel some sympathy for Government policy makers when they are accused of "meddling" in affairs of which they have little knowledge (but for which they have most of the funding responsibility), if universities themselves are not prepared to tackle the issue. In future, the extent to which university self-evaluation procedures have been developed might itself become an important indicator of performance.

Anderson, J. (1989), **New approaches to evaluation in UK research funding agencies.** Concept Paper No. 9, Science Policy Support Group, London.

Aubert, J. E. (1989), Evaluation of scientific and technological programmes and policies: a selection of current experiences in OECD countries. **STI Review**, no. 6, 147-177.

Carpenter, M. P., Gibb, F., Harris, M., Irvine, J., Martin, B. R. & Narin, F. (1988), Bibliometric profiles for British academic institutions: an experiment to develop research output indicators. **Scientometrics**, 14 (3-4), 213-233.

Committee of Vice-Chancellors and Principals and University Grants Committee (1986), **Performance indicators in universities: a first statement by a joint CVCP/UGC working group.** CVCP.

Committee of Vice-Chancellors and Principals and Universities Funding Council (1990), **University Management Statistics and Performance Indicators in the UK** (1990 Edition), London.

Department of Education and Science (1986), **Evaluation of national per-formance in basic research - A review of techniques for evaluating performance in basic research, with case studies in genetics and solid state physics.** (A study by the Royal Society Policy Studies Unit, on behalf of the Advisory Board for the Research Councils and the Economic and Social Research Council). ABRC Science Policy Studies, No. 1, London.

Dolan, P. (1976), **The ranking game: the power of the academic elite.** Lincoln: University of Nebraska Printing and Dublicating Service.

Hughes, R. M. (1925), **A study of the graduate schools of America.** Oxford, Ohio: Miami University Press.

Irvine, J. (1989), Evaluation of scientific institutions: lessons from a bibliometric study of UK technical universities. In: D. Evered (ed.), **The evaluation of scientific research.** Chichester: Wiley, 141-168.

Irvine, J., Martin, B. R. & Isard, P. A. (1990), **Investing in the future - An international comparison of government funding of academic and related research.** Aldershot: Edward Elgar.

Jackson, R. (1989), U. K. research policy. **Science and Public Affairs**, 4, 51-55.

Jones, L. V., Lindzey, G. & Coggeshall, P. E. (1982), **An assessment of research-doctorate programs in the United States** (5 volumes). Washington, D. C.: National Academy Press.

Oxburgh, E. R. (1987), **Strengthening university earth sciences**. University Grants Committee, Her Majesty's Stationery Office, London.

Phillimore, A. J. (1989), University research performance indicators in practice: The University Grants Committee's evaluation of British universities, 1985-86. **Research Policy**, 18, 255-271.

Phillips, D. (1988), A strategy for science in the UK. **Science and Public Policy**, 15(1), 3-12.

Webster, D. S. (1986), **Academic quality rankings of American colleges and universities**. Springfield, Ill.: Thomas.

Ziman, J. (1987), **Science in a "Steady State" - The research system in transition**. Concept Paper No. 1, Science Policy Support Group, London.

Ziman, J. (1989), **Restructuring academic science: A new framework for UK policy**. Concept Paper No. 8, Science Policy Support Group, London.

Author's address:

Dr. Hans-Dieter Daniel
Universität Konstanz
Sozialwissenschaftliche Fakultät
Fachgruppe Psychologie
Postfach 5560

W-7750 Konstanz