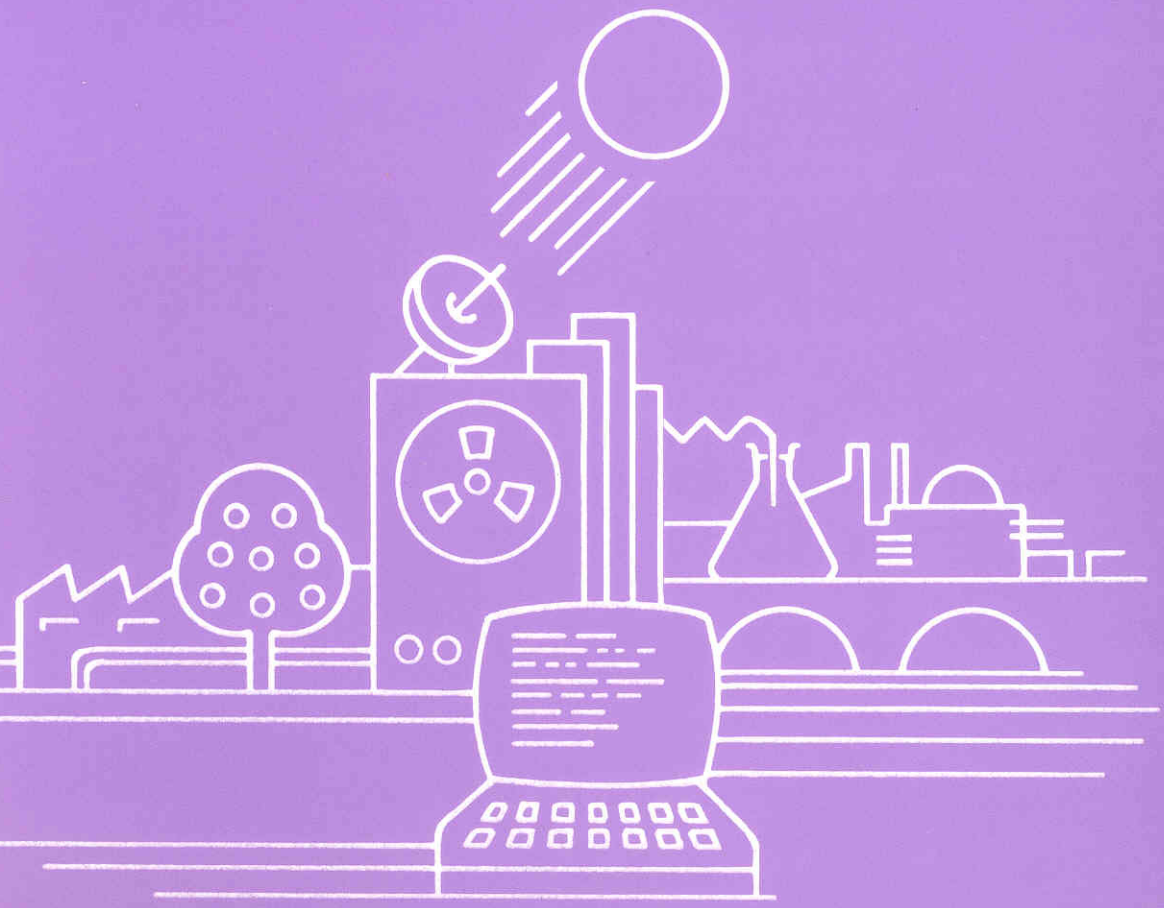
Evaluation Methodology for Research Productivity of Universities

E. Kehat, Y. Aharoni, D. Kohn, G. Czapski, E. Nissim, U. Rappaport



Studies in Science Policy

Technion - Israel Institute of Technology
The S. Neaman Institute for Advanced Studies
in Science and Technology

Evaluation Methodology for Research Productivity of Universities

Evaluation Methodology for Research Productivity of Universities

by

Ephraim Kehat

Yair Aharoni

David Kohn

Gideon Czapski

Eliahu Nissim

Uriel Rappaport

August 1992

Evaluation Methodology for Research Productivity of Universities

by

Ephraim Kehat, Yair Aharoni, David Kohn, Gideon Czapski

Eliahu Nissim, Uriel Rappaport

ISBN 965-386-011-9

Published by the S. NEAMAN INSTITUTE PRESS, August 1992

Technion City, Haifa, 32000, Israel

CONTENTS

OBJECTIVE OF THE STUDY

The objective of this exploratory study was to develop a methodology to estimate research productivity of academic units, which may be used also for disciplines where bibliometric data are not available.

For this purpose peer recognition items which may be integrated into a comprehensive number related to research productivity were tested on a limited scale.

INTRODUCTION

In most countries, the main allocation of funds to universities by government ministries or University Grant Committees is for the purpose of teaching, and the funds for research come from separately funded agencies on a competitive basis. Some or most of the government research funds are allocated to government research institutes on an historical basis or by a competitive system. The shrinking budgets for higher education and research in most countries have forced the authorities to scrutinize closely what they get for their money. This has led to a proliferation studies of evaluation of research productivity, in particular when the question rises where to fund a new research activity.

The commonly used methods of evaluation of research productivity are:

- Reports of visiting committees or evaluation committees.
- Peer reviews.
- Bibliometric analysis.

Each of these methods has its advantages together with its distinct disadvantages:

Reports by visiting committees may be biased by the choice of the committee members. Members of visiting committees are often very busy people, which makes it difficult to get them together or to get them to write the reports.

The results of peer reviews depends on what questions are asked and how they are phrased. It was suggested that an open review using the Delphi method may be used, provided that the members disclose the reasons for their choices. When evaluating academic units it is difficult to ask for too much objectivity from peers who may think that their own academic unit is the best on Earth.

In many fields there exist competing schools of thought, members of which will not think highly of any publication that does not follow their own school of thought.

Bibliometry, i.e. the quantitative measurement of citations of research publications has a number of inherent drawbacks:

- The choice of the relevant or the important journals.
- The period of publications and the period of citations.
- Normalization for the research area (the number of people active in the area affects the number of citations).
- Screening of self citations or negative citations.
- Normalization for multi-author publications.

Giving weights to different types of publications and to multi-author] a research paper will get [9 publications is problematical. Typically (or more), a paper in a book a weight 4 f 0, a book a weight 1 a weight of and for multi author papers the weight will be divided by the 0.75 of number of the authors. The last may be unfair to the one who contributed the most to the paper.

Bibliometry has been used mainly for the evaluation of science and academic units [3], and to a limited extent for the social sciences.

No computerized bibliometric databases are available at this time for the humanities. Staff members of various disciplines of humanities are commonly expected to present the results of their research in book form. A book will be published more years after the research effort, than a paper, and it is more likely that a relatively young author of a book is by then active at another university. Most other disciplines do not require publication of books, and books are generally not covered by citation indices.

It was estimated that the cost of the best possible evaluation of research productivity can reach 5-10% of the total research appropriation [1]. Moreover, it can be expected that each change appropriation method would inevitably cause a behavioral change in the universities, which will require changing the appropriation method every few years.

Most of the research in bibliometry has been conducted on Science departments. It has been stated that despite its shortcomings, [3] bibliometry can be used to rank science departments in similar disciplines.

In the social sciences bibliometric studies [10,11] generally count publications only in the "top" journals.

Ranking of departments can also involve a combination of factors, such as popularity, budgets, peer rankings, student rankings, enrollment, size of graduate school etc. . [12,13].

RESEARCH PRODUCTIVITY

The use of bibliometry as the sole measure of research productivity implies that the only objective of research is to give a wide exposure for the results of the research by publishing them in a good journal that is read by many peers.

Since about half of the published papers are never quoted, except by their authors, it does not mean that half of the research done is worthless, since such research results may be directed at the industrial user who rarely reads the more academic papers that are published in the best academic journals, and does not write many papers that cite the papers he has read.

At the other extreme we find much quoted papers by a small group in a minor area, that read and quote all the papers published in that narrow area, while these publications are ignored by industry and by most of the rest of the academic community.

In some areas, a paper is not the result of a well designed and executed research project, but an observation of an occurrence or an idea, such as case descriptions by physicians, which are the bulk of the medical literature (and sometimes convey very important and useful information) or some of the publications in areas such as law, journalism or literature. Some of these non research publication may have an impact on the well being of the general public far more than research publications, e.g. the many articles published in newspapers in Israel in the past year about direct elections of the prime minister had an important influence on getting the law for direct elections of the prime minister passed.

The late Professor Goitein has refused to endorse a publication in his honor of a bibliography of all his numerous publications because his newspaper articles were not included. Evidently, he, at least, had a high opinion of those newspaper articles.

The author's name on a publication may carry different weight in different disciplines. In some areas, such as science and engineering, the names of both student and supervisor appear on the paper, with various rules of precedence. In other disciplines, such as the humanities and some social sciences only the name of the student appears on the paper, and the supervisor may or may not get recognition in the

acknowledgement. In many industrial and hospital environments, managers get their names on the paper of employees merely because they have hiredor are supervising the person who did the research, or have provided the funds for the research.

The number of publications of an academic researcher are a function of his position on the time scale of the "publish or perish" ladder. The number of publications per year generally peaks before each promotion and peter down to a trickle after he or she reaches the top of the academic ladder. Perhaps because the researcher can afford not to publish minor or less successful research projects or because by that time his or her research spark was extinguished by the system or by old age.

The average yearly number of publications varies with the discipline, and also the type of publication (papers in journals or books). In some disciplines the creativeness is important and not the number of publications. i.e. in architecture, art, creative literature, music. Though in academic circles, sometimes, more weight is given to the criticism of artistic creativity than to the creativity itself.

Occasionally a single creative work can continue to have an impact for many years, like the movement (dance) notation by

Eshkol and Wachman. Professor Wachman did not pass the university tenure criteria when his tenure was considered by the university committees, and only student demonstrations and public opinion forced the university committees to reconsider his case.

The above discussion leads to a conclusion that bibliometry is not sufficient as a measure of research productivity, and that additional elements are required for that purpose.

A recent attempt to define research productivity [4] divides research productivity into two groups:

1. Theoretical productivity such as:
   A journal paper in Hebrew.
   A journal paper in English.
   A chapter in a Hebrew book.
   A chapter in a foreign language book.
   A book in Hebrew.
   A book in a foreign language.
   A presentation at a meeting in Israel.
   A presentation at a meeting abroad.
   An internal research report.
2. Applied productivity such as:
   Negotiations for application of an invention or an idea in Israel or abroad.

Application of an invention or an idea in Israel or abroad.
Broad application of an invention or an idea in Israel or abroad.
Registration of a patent in Israel or abroad.
Selling the rights to a patent.

Most university promotion committees recognize that publications are not the only criteria for evaluation of research productivity, and it is common to evaluate additional factors for many disciplines, i.e. the development of new surgical techniques by surgeons, the organization and execution of large scale diggings and museum shows by archaeologists, the design of impressive or efficient structures by architects, quotations in Supreme Court decisions, for law professors. These additional factors are obtained by letters from peers or supervisors.

Additional factors considered by this research team as useful elements of information for the evaluation of research productivity are the indicators of recognition by peers such as:

- Election to a national or a foreign academy
- Receiving important national or international prizes.
- Appointment as Editor, or member of editorial boards of top journals.
- Appointment as Fellow of an international professional society.

- Invitation to present a keynote presentation or a plenary lecture at a meeting of a professional society.
- Appointment to serve on prize or fund allocation committees.

On the other hand, some honors, such as appointments to the boards or as presidents of professional societies, or chairing meetings or sessions in meetings may have a strong political factor in the appointment. In the evaluation of an academic unit, an additional factor of its original contribution to research can be the number of foreign visitors who come to spend some time working with members of the department, excluding visitors who are financed by the local university.

These considerations led to the form of the questionnaire used in this study.

POLICIES OF BUDGETING UNIVERSITY RESEARCH IN VARIOUS COUNTRIES

In Britain [5] The established method over many years for allocation of research funds to universities was on an historical basis, modified by changes of the size of the student population. As available funds decreased in the eighties, it was proposed in

1987 to concentrate theresearch in a small number of research universities (Such suggestions are often made here too). After public protests this proposal fell, and the allocations are determined by periodic evaluation of the strength of the research in all active research areas at the universities. The evaluation method (at least for science and technology oriented universities where most of the funds for research are allocated, has recently been switched from peer reviews to bibliometric studies accompanied by additional measurements of research impact [6].

Another change that took place in Britain in the eighties involved the increased emphasis on applied research, cooperation with industry and interdisciplinary research. As a result, basic research was badly hurt, and this led to the foundation of a movement to "Save British Science" which was joined by about 5000 scientists and eventually led to the increased budgets for basic research in 1989 and 1990.

In Germany peer reviews are used for allocation of research funds to universities. In addition, some of the funds are earmarked for areas that are declared to have national or international priority [5].

In France the allocation of funds to universities is political and the final authority is the president. Funds are allocated mainly to outstanding research centers and to areas of national or political importance. The national research institute CNRS which is very centralized and employs directly large numbers of scientists, also funds collaborative research in universities. About half of the staff of the universities are not engaged in research, and some of the existing research is not considered to have high standards. This is why the universities objected to the suggestion of introducing a system of evaluation of the research at universities [5].

In Holland national research support was directed in the eighties mainly to applied research, however, the policy was reversed io order to emphasize basic research in the early nineties. Evaluation is performed mainly by peer reviews [5].

In the U.S.A. government research funds are allocated through organizations like NSF and NIH. The evaluation is on the basis of peer reviews, with part of the funding earmarked to help young researchers, and part of the funding at a few universities going to start research designated as having national priority. Some of the funding is directed by political pressures or by social pressures [5].

In Japan research funds are allocated to universities on historical basis, with a recent trend to allocate part of the funds to subjects or disciplines declared as having a national priority [5].

In Israel the allocation of research funds by the University Grants Committee is based mainly on the numbers of degrees granted, with an allowance for the higher cost of experimental research. The evaluation of the research productivity at the university is based on the number of grants received from bi-national and national funds, by the numbers of doctorate candidates, the number of publications, and the research funds obtained by the universities [7]. About $MM13 are allocated to the fund for basic research, run by the National Academy of Science, and these are allocated on a competitive basis judged by extensive peer reviews [8].

THE PROCEDURE OF THE STUDY

The time table of the study was:

March - April 1992 :	Develop the questionnaire
May 1992 :	Send out the questionnaire
June - July 1992 :	Analyze the results and write the report.

Due to the limited time scale, it was decided to skip the usual preliminary test of the questionnaire on a small group of people. Four science department in two disciplines in two universities were picked for the study. The original intention was to pick two departments that are similar in size and quality and two that are different in size and quality. However, the quality criteria were too subjective, and will not be referred to.

The combined active staff of these departments had 187 persons in the university year 1981/2 as taken from catalogs and with the help of members of the research team who were familiar with those departments. All 4 departments had very few persons at the lowest grade of lecturer, indicating that there were few changes in the staff in the past few years.

In addition to the mailed letter (Appendix B) and questionnaire (Appendix A), a telephone follow up was used to encourage the recipients to fill the questionnaires.

We have also attempted, unsuccessfully, to obtain data related to funded research support for each of the 4 departments.

The questionnaire (Appendix I) was designed to require only a few minutes of the recipients time, and yet many people were reluctant to fill it. By the cut off date of June 12 only 81 filled

questionnaires were received. Four questionnaires were resent to the recipients due to uncertainty of the time period the answers covered. These were returned promptly.

The percentage of returned questionnaires by the cut-off date was 43%. If it is assumed that a seventh of the target people were away on Sabbatical leave, the percentage of returned questionnaires by the cut-off date was 51%.

The ISI database taken from Science Citation Index for papers published under Israeli addresses for 1984-90 was searched for the members of the 4 departments. The number of articles, number of citations and the number of citations for the most popular article were summarized. No manipulations were conducted on the database to exclude self citations or to change the weight of multiple author papers. An earlier Neaman Institute study [2] showed that about 30% of the publications of Israeli scientists in the period 1974-1983 are not covered by the ISI database, and therefore, our database that contained only the publications with Israeli addresses was assumed to cover about 70% of the Israeli publications for 1984-90.

The data from the filled questionnaires and from the ISI database for the persons who have filled the questionnaire were loaded into a spreadsheet program, and most of the analysis was

made, using the spreadsheet functions and graphics.

Table I is a summary of the raw data from the questionnaires and the ISI database for 81 persons, excluding identifying information, such as name, department and year of birth. The first 3 columns are a serial number, grade (1 = lecturer, 2 = senior lecturer, 3 = associate professor, 4 = professor), and the year of start at the university. The next 22 columns are the answers to the 4 parts of the questionnaire. The next 3 columns were taken from the ISA database: the number of papers, citations and citations per paper, and the last column is the sum of recognitions, as will be explained later.

Table I : Raw data

GRADE	Yr Start	QUESTIONNAIRE																				PAPERS	CITED	CIT/PAP	RECOGNITION
		1					2			3				4											
		A	B	C	D	E	A	B	C	A	B	C	D	A	B	C	D	E	F	G	H	I				
1	4 1969	0	0	1	15	6	1	0	4	0	0	0	0	0	0	0	0	0	2	0	2	1	11	21	1.9	3
2	4 1966	0	0	1	10	6	2	0	7	1	0	0	2	1	0	1	0	0	1	2	2	1	2	4	2	7
3	3 1970	0	0	0	12	7	0	0	8	2	0	1	1	0	3	0	0	0	0	0	1	0	7	15	2.14	4
4	4 1979	0	1	1	31	0	1	0	5	0	0	0	0	1	0	0	0	0	11	0	6	1	33	176	5.33	8
5	4 1973	0	0	1	40	13	2	2	6	0	0	0	2	0	0	0	0	0	10	1	3	0	13	56	4.30	4
6	3 1969	0	0	0	10	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0.33	0
7	4 1969	0	0	0	20	3	3	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	28	307	10.9	0
8	4 1969	0	0	0	8	14	2	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	34	3.77	0
9	4 1972	0	0	2	12	25	2	4	4	0	0	0	0	1	0	0	0	0	0	0	2	0	34	317	9.32	3
10	3 1956	1	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	9	2.25	0
11	2 1991	0	0	0	15	5	0	0	2	0	0	0	0	0	1	0	0	0	5	0	2	0	0	0	0	3
12	3 1981	0	0	1	20	10	4	1	5	1	0	0	0	0	0	0	0	1	5	0	1	0	13	58	4.46	2
13	4 1983	0	0	1	18	0	2	1	4	0	0	0	0	0	0	0	0	0	1	0	1	0	6	61	10.1	1
14	3	0	0	0	28	12	4	3	0	0	0	0	0	1	0	0	0	0	3	0	1	0	23	44	1.91	2
15	3	0	1	0	10	6	3	0	3	0	0	0	0	0	0	0	0	0	2	0	2	0	8	27	3.37	2
16	5	0	0	0	17	11	2	2	2	0	0	0	0	2	0	0	0	0	8	1	0	0	18	102	5.66	3
17	4 1967	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7	21	3	1
18	4 1967	0	0	1	4	6	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	15	43	2.86	3
19	4 1969	1	0	3	39	0	5	2	4	1	0	0	0	1	0	0	0	0	1	5	1	4	5	15	3	11
20	4 1959	0	0	0	6	5	1	1	6	0	0	0	1	0	0	0	0	0	0	0	0	0	7	24	3.42	0
21	4 1981	0	0	2	43	7	3	5	5	0	0	0	0	0	0	0	0	0	13	0	4	2	12	44	3.66	6
22	3 1975	0	0	0	48	17	4	0	5	2	1	0	0	0	0	3	0	0	4	0	0	2	9	122	13.5	5
23	4 1956	0	0	1	9	0	5	3	2	0	0	0	0	1	0	0	0	0	0	2	0	1	12	10	0.83	4
24	4 1976	0	0	0	25	18	5	3	2	8	1	1	0	0	0	0	0	0	8	0	0	0	56	553	9.87	0
25	4 1968	1	1	4	79	19	1	4	3	0	0	0	0	9	1	2	0	2	*	0	4	0	108	651	6.02	18
26	4 1965	0	1	2	47	0	0	0	3	0	0	0	0	3	0	0	0	0	3	0	0	0	43	269	6.25	3
27	4 1967	0	0	2	25	1	8	5	7	0	0	0	2	0	0	2	0	0	5	5	4	2	40	195	4.87	13
28	4 1965	0	12	1	36	20	1	2	6	0	0	0	0	3	1	0	0	0	5	x	0	0	54	427	7.90	4
29	4 1968	2	0	2	22	4	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	18	123	6.83	0
30	4 1976	0	3	4	40	2	2	1	9	0	0	0	0	3	1	0	1	0	32	1	9	0	91	911	10.0	15
31	4 1956	2	6	1	36	3	1	2	4	0	0	0	0	2	0	0	1	0	4	2	1	0	35	80	2.28	6
32	1 1990	0	0	0	15	7	0	0	6	0	0	0	1	0	0	0	0	2	0	0	0	0	15	172	11.4	2
33	4 1962	0	0	0	15	10	1	2	2	0	0	0	0	0	1	0	0	0	0	0	1	0	14	86	6.14	2
34	4 1954	0	2	3	14	10	0	1	2	0	0	0	0	3	0	0	0	0	*	2	1	0	13	133	10.2	6
35	4 1963	0	0	1	13	3	1	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	13	34	2.61	0
36	4 1971	0	0	4	20	0	4	1	8	0	0	0	0	2	0	0	0	0	4	0	2	1	43	189	4.39	5
37	4 1990	0	0	0	29	2	1	1	6	0	0	0	0	0	0	0	0	0	2	0	5	0	79	952	12.0	5
38	4 1957	0	0	0	18	5	1	1	0	0	0	0	0	1	0	0	0	0	1	1	2	0	17	34	2	4
39	4 1967	0	1	5	28	15	0	1	3	1	0	0	0	0	0	0	0	0	4	0	1	0	39	222	5.69	1
40	4 1978	0	0	5	12	4	1	4	3	0	0	0	0	0	1	0	0	1	1	2	0	0	10	55	5.5	4
41	3 1988	0	0	0	10	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0.33	0
42	4 1969	0	0	0	12	8	0	0	2	0	0	0	0	1	0	0	0	0	6	0	7	0	17	115	6.76	8
43	4 1951	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	4 1968	8	0	0	0	0	3	0	5	0	0	0	0	0	0	0	0	0	0	0	4	0	4	11	2.75	4
45	? 1982	0	0	0	24	0	3	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	19	60	3.15	0
46	3 1968	0	0	2	110	14	2	1	6	0	0	0	0	0	2	2	0	0	8	0	4	0	59	367	6.22	8

Table I (Cont.) : Raw data

GRADE	Yr Start	QUESTIONNAIRE																				PAPERS	CITED	CIT/PAP	RECOGNITION
		1					2			3				4											
		A	B	C	D	E	A	B	C	A	B	C	D	A	B	C	D	E	F	G	H	I				
47	4	1968	1	0	2	17	19	1	0	2	0	0	0	0	0	0	0	1	0	16	1	2	0	7	80	11.4	4
48	4		0	0	2	17	5	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	12	33	2.75	1
49	3	1965	0	0	0	6	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	11	2.2	0
50	3	1972	0	0	0	11	2	3	2	1	2	0	0	0	1	0	0	0	0	0	0	0	0	6	11	1.83	1
51	3	1971	0	0	0	12	10	0	0	2	0	0	0	1	0	0	0	0	0	0	0	1	0	8	25	3.12	1
52	4	1963	0	0	2	29	1	4	2	9	0	0	0	0	4	0	1	0	0	1	0	3	1	44	190	4.31	9
53	4	1976	0	0	3	27	10	3	1	5	0	0	0	0	2	3	0	2	2	14	0	4	2	28	405	14.4	15
54	4	1970	0	0	3	1	4	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	6	12	2	0
55	4	1990	4	?	2	24	3	2	3	4	3	2	0	1	1	1	0	0	0	2	2	2	0	22	60	2.72	6
56	3	1986	0	0	0	30	20	3	2	6	0	0	0	0	0	0	3	0	0	4	0	4	0	17	142	8.35	7
57	4	1980	0	0	0	10	4	3	1	1	0	0	0	0	0	0	0	0	0	4	0	3	0	7	47	6.71	3
58	4	1964	0	0	0	7	9	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	28	7	0
59	4	1971	0	0	2	12	3	2	4	2	5	0	0	2	0	0	0	0	0	2	0	2	1	15	119	7.93	3
60	3	1975	0	0	0	19	6	0	1	6	0	0	0	0	0	0	0	0	0	2	1	1	0	25	126	5.04	2
61	3	1969	0	0	0	5	1	2	1	1	1	3	0	1	0	0	0	0	0	2	0	0	0	3	7	2.33	0
62	2	1983	0	0	0	25	2	6	3	4	1	2	0	1	0	0	0	0	0	8	0	3	0	21	55	2.61	3
63	2	1988	0	0	0	6	2	2	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	9	99	11	0
64			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	0
65	4	1989	0	0	1	10	12	1	1	4	0	1	1	0	0	0	0	0	0	2	4	3	0	13	77	5.92	7
66	4	1965	0	0	1	14	1	0	0	1	0	0	0	0	0	1	0	0	0	2	0	1	0	26	134	5.15	2
67	4	1968	0	1	0	8	2	0	2	6	0	0	0	0	0	0	2	0	0	2	2	1	1	10	0	0	6
68	2	1984	0	0	1	17	3	1	2	5	0	0	0	0	0	0	0	0	1	0	0	0	0	26	89	3.42	1
69	4	1988	0	0	0	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
70	4	1954	0	0	0	7	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	12	35	2.91	1
71	3	1980	0	0	0	10	5	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	11	37	3.36	1
72	4	1971	0	1	0	11	15	3	2	2	2	0	0	0	1	0	0	0	0	0	0	0	0	13	56	4.30	1
73	3	1982	0	0	0	16	1	3	0	5	0	0	0	0	0	0	0	0	0	6	0	0	0	21	224	10.6	0
74	4	1952	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	8	70	8.75	0
75	4	1967	0	0	1	22	5	2	1	0	2	0	0	0	0	0	0	0	0	5	0	0	0	22	60	2.72	0
76	3	1965	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	2	0	1	0	2	4	2	1
77	4	1972	0	0	0	15	13	3	1	5	1	1	1	0	0	1	0	0	0	1	1	2	0	15	65	4.33	4
78	3	1975	0	0	1	7	2	2	1	4	2	1	0	0	0	0	0	0	0	5	0	0	0	11	17	1.54	0
79	2	1991	0	0	1	35	10	0	1	6	0	0	2	0	0	0	2	0	1	0	0	1	0	4	24	6	4
80	4	1980	0	5	0	30	15	2	2	3	0	0	0	0	2	0	0	2	0	5	0	5	0	31	287	9.25	9
81	4	1980	0	1	10	?	?	5	3	10	2	0	0	2	1	0	4	0	1	30	0	2	0	87	929	10.6	8

THE RAW DATA

The ISI database

For each person the maximum number of citations for a single paper was extracted. (This column is not included in Table I due to lack of space). A very large number of citations for a single paper can distort the averages for a department. However, the largest number of citations of a single paper was 165 for 3 people in the same department, who had a total number of citations of 536, 637 and 423 respectively, with 4300 citations for the whole department. This was not considered as liable to distort the averaging procedure.

The 81 filled questionnaires

Group 1.

The 5 questions in the first group of questions were designed to serve as a check of the ISI database and to highlight, perhaps, some types of publications, such as books or chapters in books.

1-a : Number of books written during 1986-1990: Two persons reported 1 book each, two persons reported 2 books each, one person reported books and one person reported 8 books (but only 4 papers).

1-b : Similarly 9 persons reported having edited one book, one person reported editing 2 books. Other persons reported having edited 3, 5, and 12 (!) books.

1-c : Many persons reported having written 1 to 5 chapters in books, and one person reported having written 10 chapters.

1-d : The number of reported refereed papers ranged from 0 to 110 in five years.

1-e : The number of reported refereed papers in meetings ranged from 0 to 25.

With one exception (noted above in 1-a), the prolific writers of chapters an editors of books have also published large numbers of papers.

Most persons reported writing more papers for journals than for conferences. A few persons reported more presentations in meeting than papers. Most of the last group published a small number of papers.

A comparison of the reported number of papers in 1986-1990 with the numbers generated by the ISI database for 1984-1990 cannot be made, since the ISI database covered a longer period, but did not cover all the papers written by the sample groups. Hopefully, these two effects might have roughly cancelled each other. However, for 9 persons the number of ISI papers was less than half of their reported number, and for 7 persons the ISI number was more than double their reported number.

In the following discussion the number of papers was taken from the ISI database and not from the reported numbers in the filled questionnaires. (The only exception was the sum of Group 1 as the total number of publications used for Table II.

Group 2.

The 3 questions of the second group of questions were designed to study the attraction of graduate students to a staff member, and the staff member's ability to finance his or her research.

The filled questionnaires show that there is no correlation between the number of M.Sc. and Ph.D. graduates and the number of papers. In most (but not all) cases full professors appear to attract more graduate students than lower grade staff, but this includes also persons who write few papers. The most

prolific writers either write a large number of papers from each thesis, or have technicians who generate much data.

The larger current research groups belong often (but not always) to the more prolific writers of papers. It is probable that the more prolific writers of papers, who are often also the more cited, tend to write more research proposals, and also to get more research funds.

Group 3.

The 4 questions of the third group of questions were designed to study the effect of applied research on the number of papers or recognition.

Twenty six persons reported involvement in applications of research. Most of these people publish less than the average, but a few prolific publishers, and inventors raise the average number of the reported publications for this group to 17.3 per person vers 20.0 for all 81 persons reporting. The number of reported recognitions was 3.34 per person for these 26 persons vers 3.46 for the 81 persons reporting, indicating that applied research may decrease the publication rate but not the recognition.

Group 4.

The 9 questions of the fourth group were designed to deliver the alternative to citation counting, by peer recognition. We have excluded factors, such as academic administrative positions and chairing meetings or sessions at meetings, where internal politics is often a dominating factor, and tried to highlight factors that are indications of academic peer recognition.

The questions may not have been phrased clearly enough, since one Associate professor reported three appointments as a fellow of professional societies, and another associate professor reported 3 membership in academies. The greatest disparities were in the answers to question 4-f (number of plenary or keynote papers in meetings). Many people must have included invited papers, which we have excluded, since many invitations for papers are only sent in order to get an adequate number of participants in the conference. A few people reported much larger numbers in this category, than the number of papers in refereed conferences. For that reason, and also since the values of the answers were much larger than the values of the other categories in this group, we have excluded the answers to this question (4-f) from the sum of the elements of recognition used in the analysis. We have not censored any of the other questionable answers, since their number was small, and we did

not want to use subjective considerations in the analysis. The current study was an exploratory study. If this study is continued, the questions 4-b, 4- and 4-f should be rephrased, in order to eliminate misunderstanding. In addition, the year of elevation to the current grade should also be asked.

Other information

We had hoped that some of the participants will offer new categories for future studies here. Many persons mentioned administrative positions in universities or societies, which we had deliberately excluded. One person had obtained prestigious research grants. One person stated that one of his publications, a few years ago, was a citation classic. (This must have been published before the period covered by our database, since he had very few citations in our database). One person manages a company. One person mentioned a university chair, though many others had chairs. Chairs are often limited to areas of interest to donors, and many great scientists do not get a chair, since their area of activity is not attractive to donors.

None of the above suggestions adds a significant item to the list of peer recognitions.

EVALUATION OF INDIVIDUALS

The dependent parameters for correlations were:

Number of papers published (from the ISI database and not the filled questionnaires)
Number of citations.
Average number of citations per paper.
Number of recognitions (Sum of group 4 less 4-f).

The independent parameters were:

Number of Ph.D. and M.sc. graduates (2-a + 2-b).
Size of current research group (2-c).
Number of applications (Sum of group 3).
Number of books or chapters in books (1-a + 1-b + 1-c).
Secondary parameters were:
Grade.
Age.
Department.

The number of recognitions could also be correlated against the other dependent parameters.

Over 40 correlations were tested, but only 9 are shown here. The many numbers on the abscissas of the figures are a characteristic of spreadsheet figures.

Figures 1-3 show the effect of current group size on the number of papers, number of citations/paper and number of recognitions. There is a slight increase in number of papers with group size, but there are some people with few publications and large research groups. The number of citations/paper is small for most (but not all) people with no research groups. It does not appear to increase with group size over most of the rest of the range of group sizes. On the other hand the number of recognitions (with exceptions) is 0-1 for people with no research groups, and there is a trend of increased recognition with increased size of research group up to a group size of about 5.

No trends were found when the dependent parameter was the number of graduates or the number of applications.

Figure 4 shows an inclination to increased number of recognitions with increased number of books and chapters in books. There are also many exceptions.

Figure 5 shows the distribution of citations vers number of recognitions which shows some increase of number of citations

with number of recognitions.

Figures 6-9 show the number of publications, citations, citations/paper and recognitions versus the grade with age as the secondary parameter within the grade.

Obviously, the older associate professors (grade 3) publish few papers, and have few citations, but some of these papers are more widely cited. For full professors (grade 4) there is an obvious trend of decrease in number of publications, citations/ paper, and specially in the number of citations with increased age.

The number of recognitions is small for the older associate professors, with the notable exception of the one who reported fellowships in 4 societies, and peaks at around age 50-60 for full professors.

Attempts to note trends by department were not successful.

EVALUATION OF DEPARTMENTS

Statistical analysis of the major elements of the raw data from Table I by departments is shown in Table II.

The first 5 groups of statistics were made for the 81 individuals that have filled the questionnaire. Average values and standard deviations for each department and for all the 81 persons were calculated for the following variables: Total number of publications, Total number of recognitions, Number of graduated M.Sc. and Ph.D. students per person, Current size of research group per person, and total number of implementations per person.

The next 3 groups of statistics were made from the ISI database for the same 81 persons. Average values and standard deviations for each department and for all the 81 persons were calculated for the following variables: Number of papers per person, number of citations per person and number of citations per paper.

For all cases the standard deviations are rather high, which fits the wide variations shown in the figures.

Department C stands out in the numbers of papers and citations per person. However, the number of citations/paper is not much higher than for Department A. Department C also stands out in the total number of publications (sum of group A) per person.

Department A stands out by the size of the research groups (which reflects the financing) and by the number of implementations per person. The number of graduates per person is similar for all 4 departments. Part A of Table III is based on the database of Table I, with the addition of the total number of recognitions normalized for the size of the department taken from the last column of Table I.

It can be seen that if the departments are ranked by the number of papers per person, the number of citations per person, the number of citations per paper and the number of recognitions per person, the rankings come out to be almost the same, with the only exception being the number of citations per paper in the ranking of the third and the fourth positions.

However, the difference in number of recognitions per person for the top department and the second one are not very significant.

In the discussions of the results by our research team, the question was raised whether people with higher research productivity tended more than those with lower research productivity to fill the questionnaire. For that purpose part B of Table III was calculated from the ISI database for all 187 members of the departments.

The number of papers per person and the number of citations per person for each department were lower for part B than for part A, showing that the suggested bias exists. Department C was still ranked at the top, though the number of citations/paper was insignificantly higher than for Department D.

Two out of the three criteria ranked Department D as number 2 and only one, the number of papers/person ranked department A as number 2 as in part A.

It should be noted that the ranking by number of papers/person remained the same for all 4 departments as in part A,

For comparison of the bibliometric criteria with the number of recognitions we should use Part A of Table III, which deals with the same population.

The bottom line is that the average number of recognitions per person for a department is as good a criterion for picking the best departmentfrom a group of departments as bibliometric methods.

The significance of this result is that the criteria of number of recognitions can be used also for comparison of departments in the social sciences and the humanities, for which bibliometric data are not available.

Table II: Statistical analysis per department

(AVE - Average per person. STD - Standard deviation)

From the database of 81 filled questionnaires

Dept	Total no. of publications		No. of recognitions		Graduates/ person		Research group		Implement/ person	
	AVE	STD	AVE	STD	AVE	STD	AVE	STD	AVE	STD
A	24.4	12.2	4.2	4.0	3.0	2.5	4.6	2.2	1.7	2.3
B	24.4	15.8	2.4	2.6	3.2	2.3	3.1	2.3	0.5	0.9
C	30.0	20.5	4.3	4.7	3.2	3.2	3.6	3.1	1.2	2.4
D	26.0	29.7	3.2	3.3	2.8	2.3	2.5	2.0	0.5	0.9
Total	26.6	20.7	3.5	3.8	3.1	2.7	3.4	2.6	0.9	1.8

From the ISI Database for the same 81 persons

Dept	Papers/ person		Citations/ person		Citations/ paper	
	AVE	STD	AVE	STD	AVE	STD
A	14.91	9.38	95.1	106.2	6.37	3.76
B	11.00	8.15	67.1	86.3	6.09	3.89
C	34.11	27.96	238.9	290.0	5.83	2.65
Total	20.02	21.07	132.2	200.5	6.60	3.50

Table III : Sums and Rankings by department

PART A:

Summaries of data of individuals for each department and normalizing per person for all people who have completed questionnaire:

DEPT	No	Tot Papers	Tot Citations	Cit/ pap	Pap/ Pers	Cit/ Pers	Recognitions/ Person
A	12	179	1141	6.37	14.91	95.08	4.16
B	24	275	1677	6.09	11.00	67.08	2.40
C	27	921	6451	7.00	34.11	238.93	4.29
D	18	247	1442	5.83	14.52	84.82	3.17

Ranking of departments by 4 criteria:

		Cit/ pap	Pap/ Pers	Cit/ Pers	Recognitions/ Person
A		2	2	2	2
B		3	4	4	4
C		1	1	1	1
D		4	3	3	3

Dept C ranked No 1 by all criteria.

Dept A ranked No 2 by all criteria.

Dept D ranked No 3 by 3 of 4 criteria, including recognitions.

Dept B ranked No 4 by 3 of 4 criteria, including recognition.

PART B:

Summaries of ISI database of all members of each department and normalizing per person:

DEPT	No	Tot Papers	Tot Citations	Cit/ pap	Pap/ Pers	Cit/ Pers
A	30	349	1641	4.70	11.63	54.70
B	50	534	2834	5.31	10.68	56.68
C	52	1363	9634	7.07	26.21	185.26
D	55	612	4300	7.03	11.13	78.18

Ranking of departments by 4 criteria:

	Cit/ pap	Pap/ Pers	Cit/ Pers	Recognitions/ Person
A	4	2	4	2
B	3	4	3	4
C	1	1	1	1
D	2	3	2	3

The recognitions/person are from the limited database of 81 respondents.

Dept C ranked No 1 by all criteria.

Rankings by papers/person was the same as ranking by recognition from the smaller database.

Rankings by citations/paper and by citations/person were the same, but differed from the other two rankings.

BIBLIOGRAPHY

1. in't Velt Roeland, The Future of Evaluation in Higher Education, Higher Education Management, 3 (2), (July 1991).
2. Frenkel Amnon, Shoam Aner, Czapski Gideon, Cooperation between Israeli and Foreign Scientists in the Experimental and Engineering Sciences, Neaman Institute Report (in Hebrew), Technion (May 1991).
3. Irvine John, Evaluation of Scientific institutions: Lessons from a bibliometric study of UK technical universities, pp 141-168 in "The Evaluation of Scientific research" , Wiley (1989).
4. Shai Shmuel, Duchin Rivka, Hershkovitz Shlomo, University Research in Israel: Intrinsic Measures of Science (in Hebrew), The Weizmann Publications Institute (1989).
5. Irvine John, Martin Ben R., Isard Phoebe A., Investing in the future, Edward Elgar Pub. Ltd., (1990).
6. Anderson J., New approach to evaluation in UK research funding agencies, Science Policy Support Group, London (1989).
7. Pazi Amnon, at a meeting with the research team on March 31, 1991.
8. Zadok Meyer, at a meeting with the research team on March 31, 1991.

9. Maoz Zeev, Outputs, Inputs and the policy of Allocation of Academic Human Resources at the Haifa University (In Hebrew), Haifa University Internal Report (March 1992).

10. Stahl M.J., Leap T.L. Wei Z.Z., Publications in Leading Management Journals as a Measure of Institutional Research Productivity, Academy of Management Journal, 31,707 (1988).

11. Johnes G., Determinants of Research Output in economics Departments in British Universities, Research Policy, 17, 171 (1988).

12. The Best Business Schools, Business Week, October 29, 1990, p. 7.

13. America's Best Colleges, U.S. News & World Report, September 30, 1991.

APPENDIX A - THE QUESTIONNAIRE

(Translated from Hebrew)

All questions except 2-C relate to the 5 years 1986-1990.

A. Publications:

1. Number of books you have written.
2. Number of books you have edited.
3. Number of chapters in other books.
4. Number of papers in refereed journals.
5. Number of papers in refereed meetings.

B. Direction of research:

1. Number of M.Sc. students graduated.
2. Number of Ph.D. students graduated.
3. Number of research students, post-docs, researchers and technicians in the group you lead.

C. Applications:

1. Number of patents issued or applied for.
2. Number of successful implementations in Israel.
3. Number of successful implementations abroad.
4. Number of items under review by external groups for implementation.

D. Recognitions:

1. Number of membership in editorial boards.
2. Number of appointments as Fellow in professional societies.

3. Number of memberships in Academies.
4. Number of prizes by international societies.
5. Number of prizes in Israel.
6. Number of keynote or plenary lectures in international meetings.
7. Number of appointments to international prize committees.
8. Number of colleagues who came to study with you for periods of over one month.
9. Number of appointments to senior national or public posts.

E. Additional information:

Personal information:

Name (in Hebrew and in English)

University:

Department:

Rank:

At university from year:

Year of birth:

APPENDIX B - THE ACCOMPANYING LETTER

(Translated from Hebrew)

May 3, 1992

Dear Colleague,

The S. Neaman Institute is currently conducting a research project to estimate research productivity at universities. In view of the increasing trend for bibliometric evaluations (Counting papers and citations), weare interested in checking additional factors which may measure research productivity or applications.

We shall appreciate it if you can spare a few minutes to answer the enclosed short questionnaire, which contains a few questions related to your research productivity or applications in the 5 years 1987 to 1991, and to send the filled questionnaire in the enclosed stamped envelope, as soon as possible. Please fill the answer to all questions, even if the answer to most question is zero.

Your answers will remain confidential. We shall use the numbers only for global analysis.

Sincerely,

Professor Ephraim Kehat, Technion - chairman.
Professor Yair Aharoni, Tel Aviv University.
Professor Gideon Czapski, The Hebrew University.
Professor Eliahu Nissim, Technion.
Professor Uriel Rappaport, University of Haifa.

FIGURE 1:

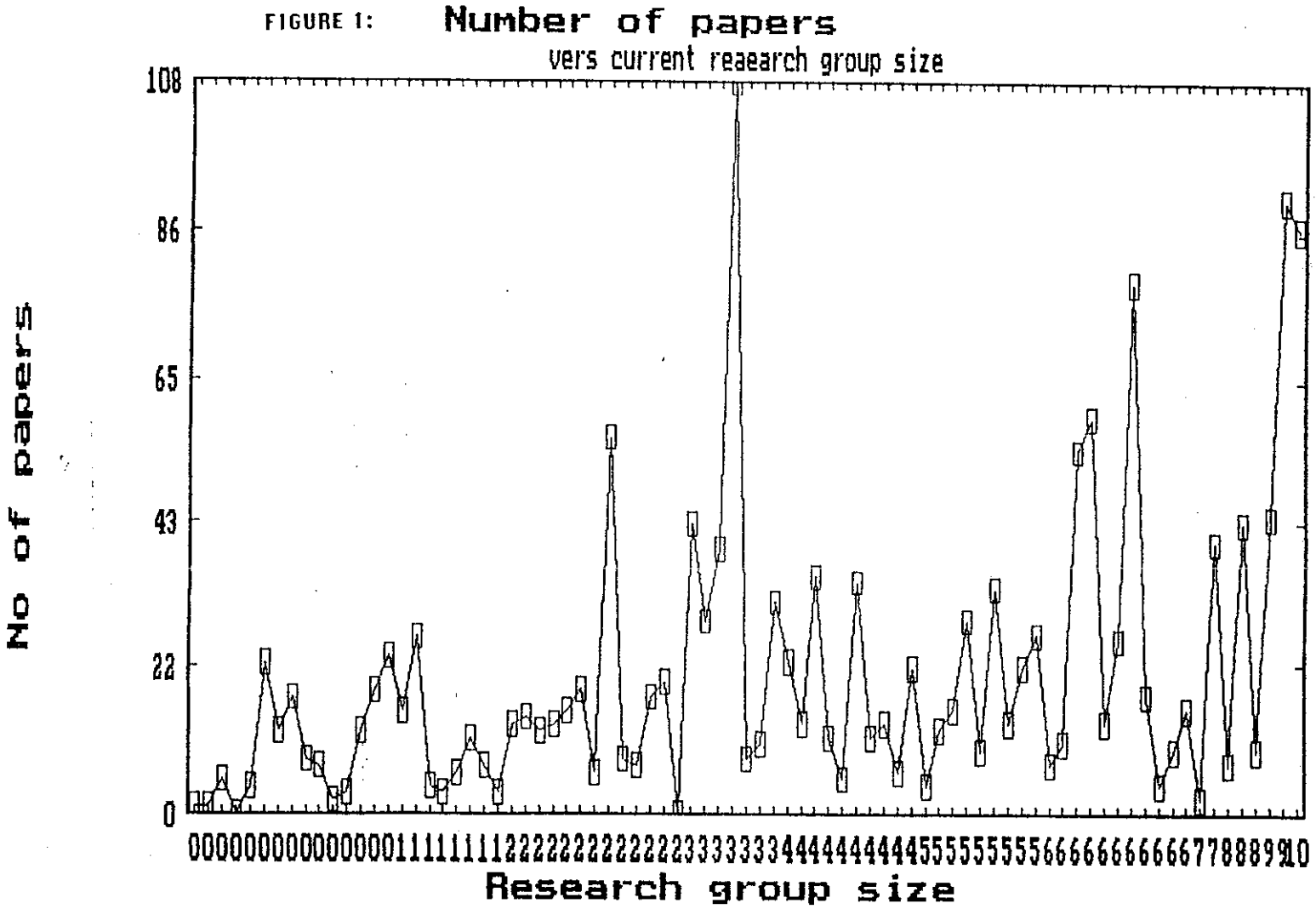

Number of papers
vers current reaearch group size
No of papers
108
86
65
43
22
0
Research group size

FIGURE 2:

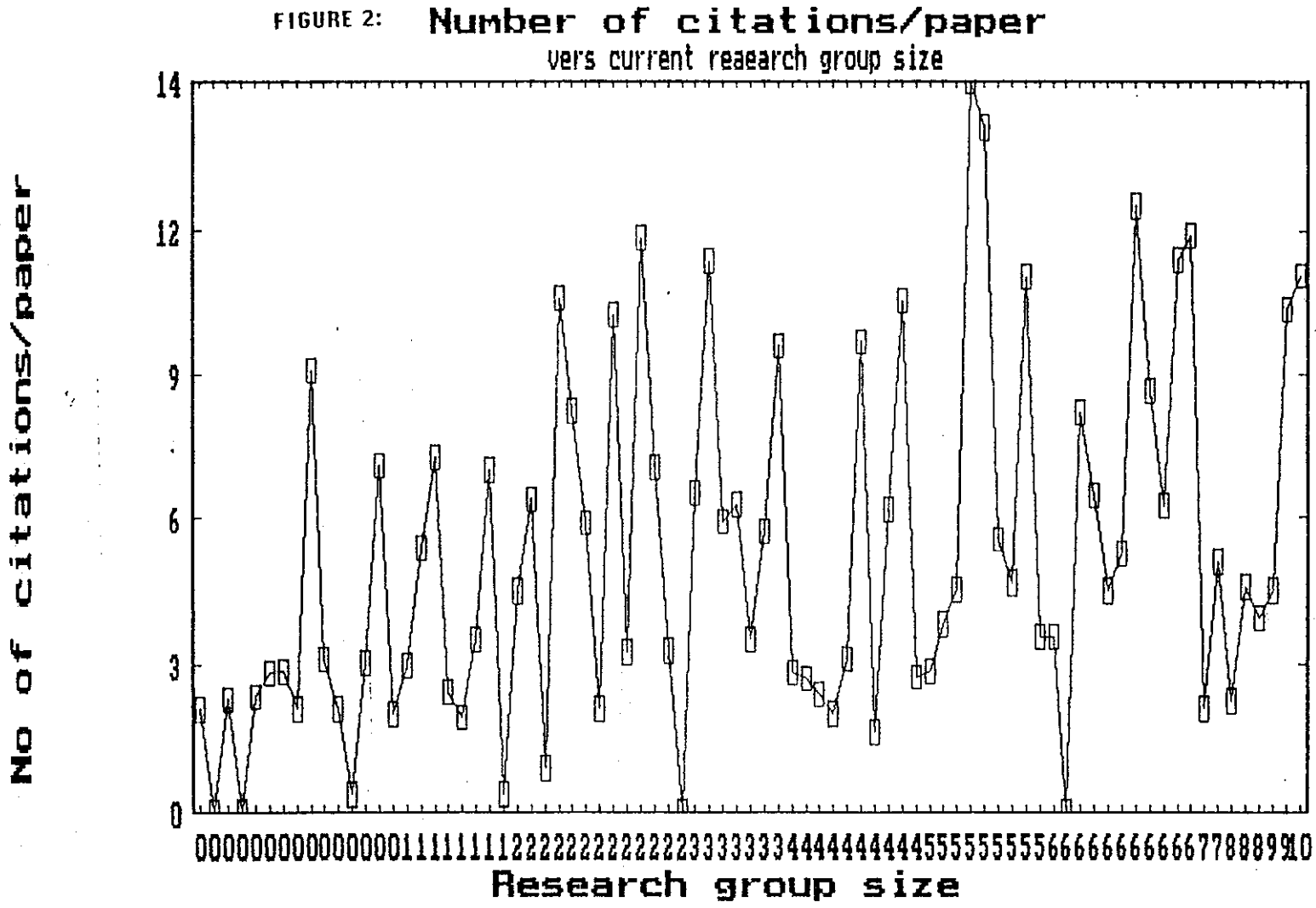

Number of citations/paper
vers current reaearch group size
No of citations/paper
14
12
9
6
3
0
0000000000000001111111122222222222233333333444444444455555555566666666666778889910
Research group size

FIGURE 3:

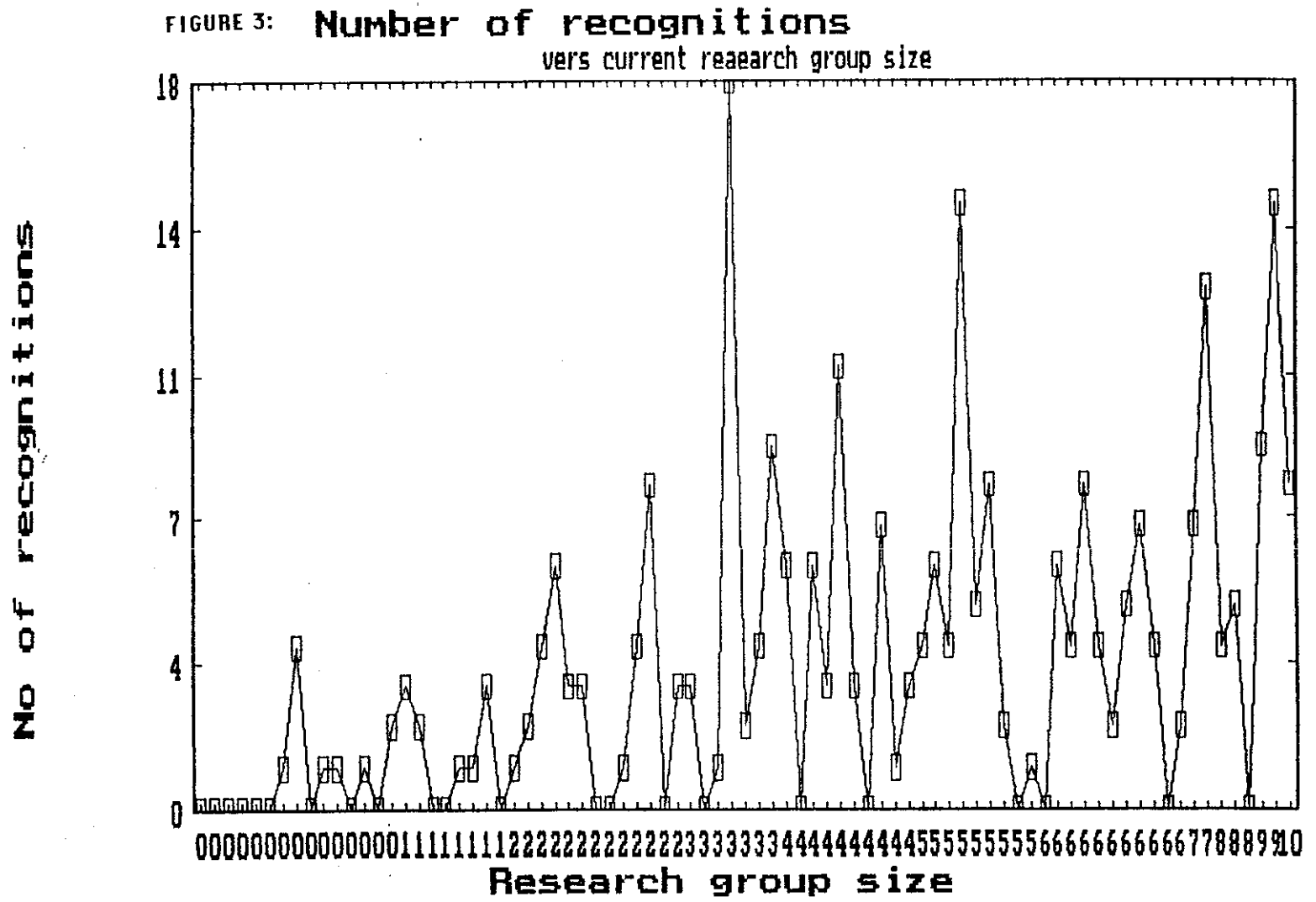

Number of recognitions
vers current reaearch group size
No of recognitions
18
14
11
7
4
0
Research group size

FIGURE 4:

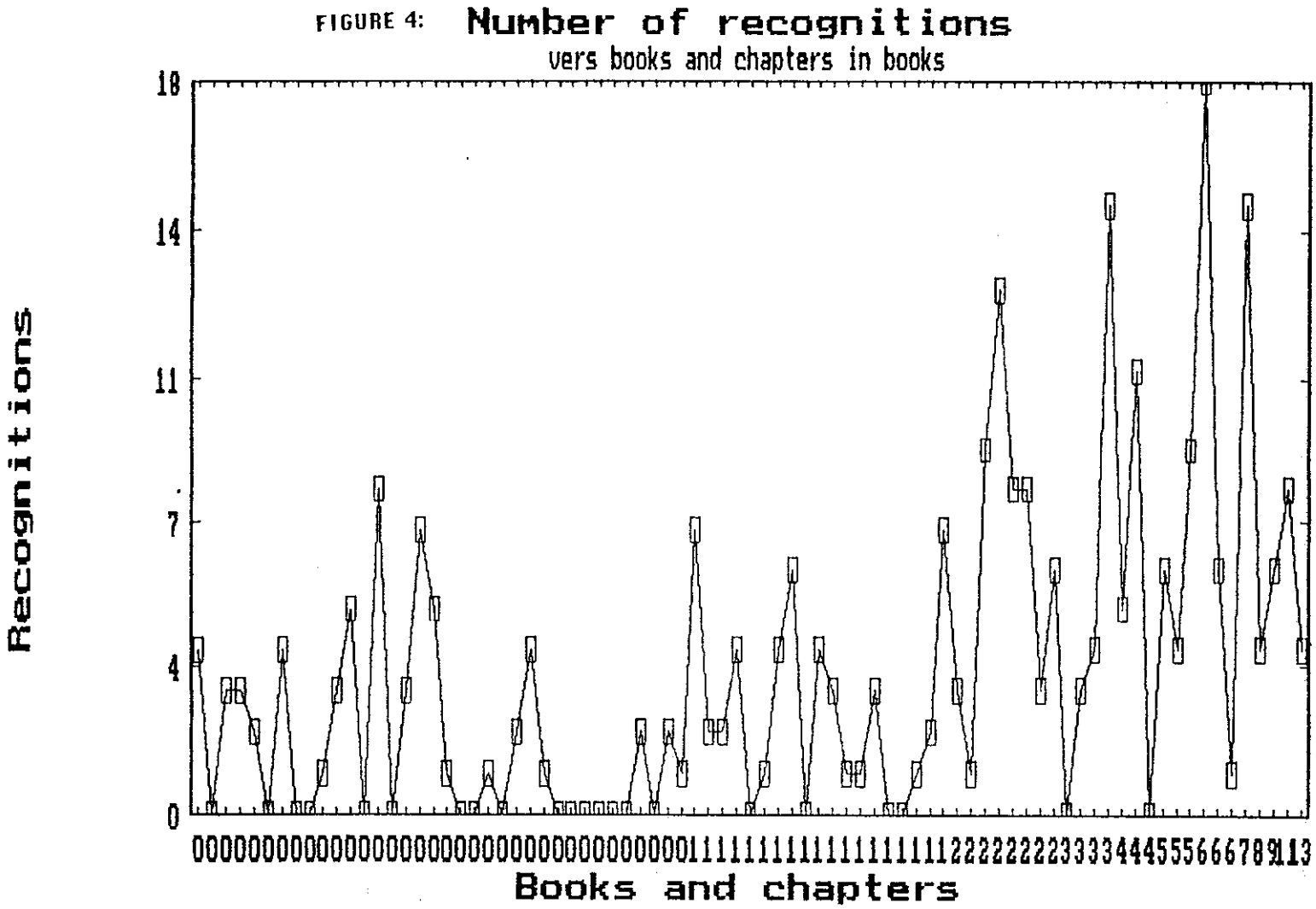

Number of recognitions
vers books and chapters in books
Recognitions
18
14
11
7
4
0
Books and chapters

FIGURE 5:

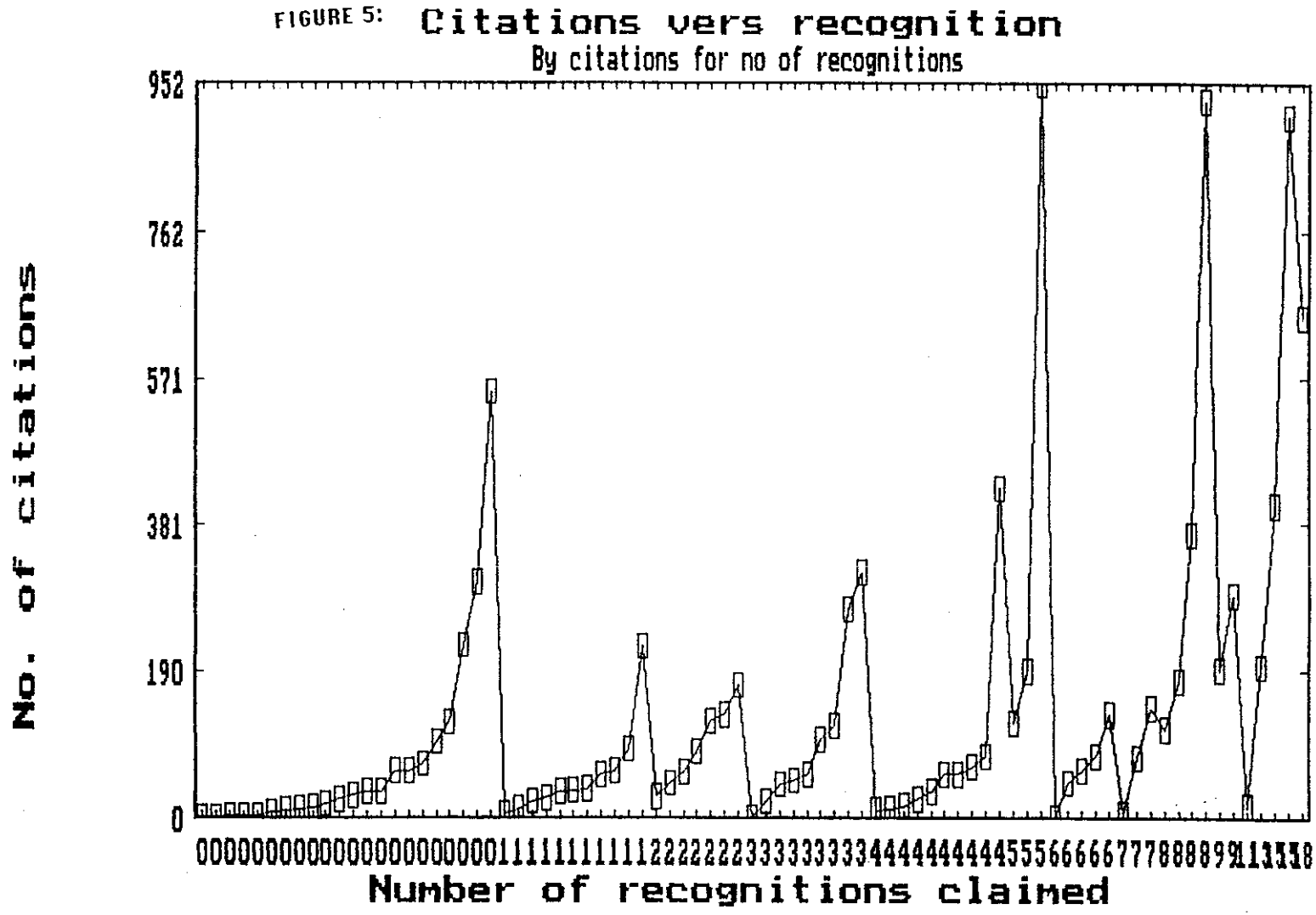

Citations vers recognition
By citations for no of recognitions
952
762
571
381
190
0
No. of citations
Number of recognitions claimed

FIGURE 6: Distribution of No. of publications

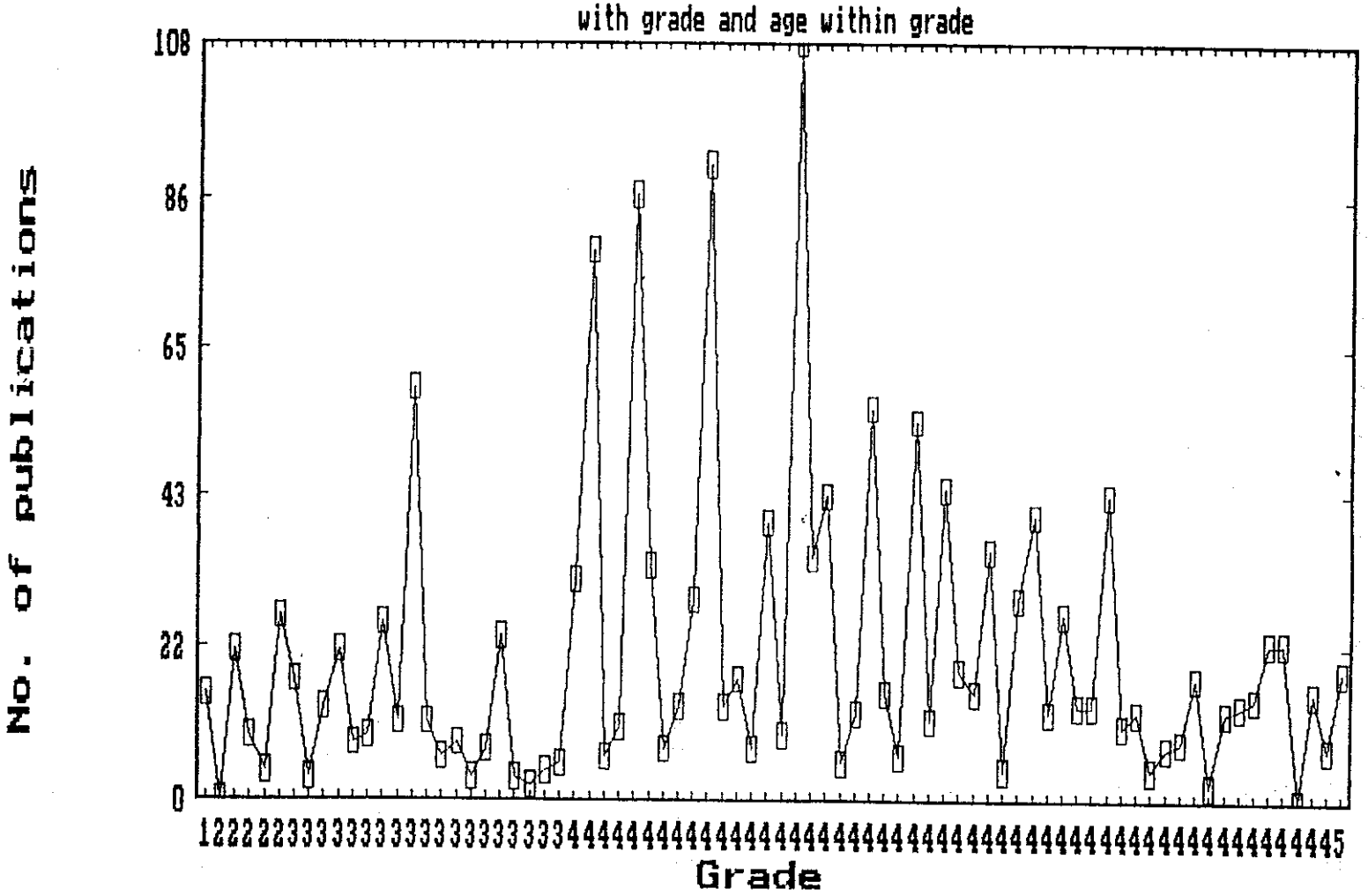


FIGURE 7:

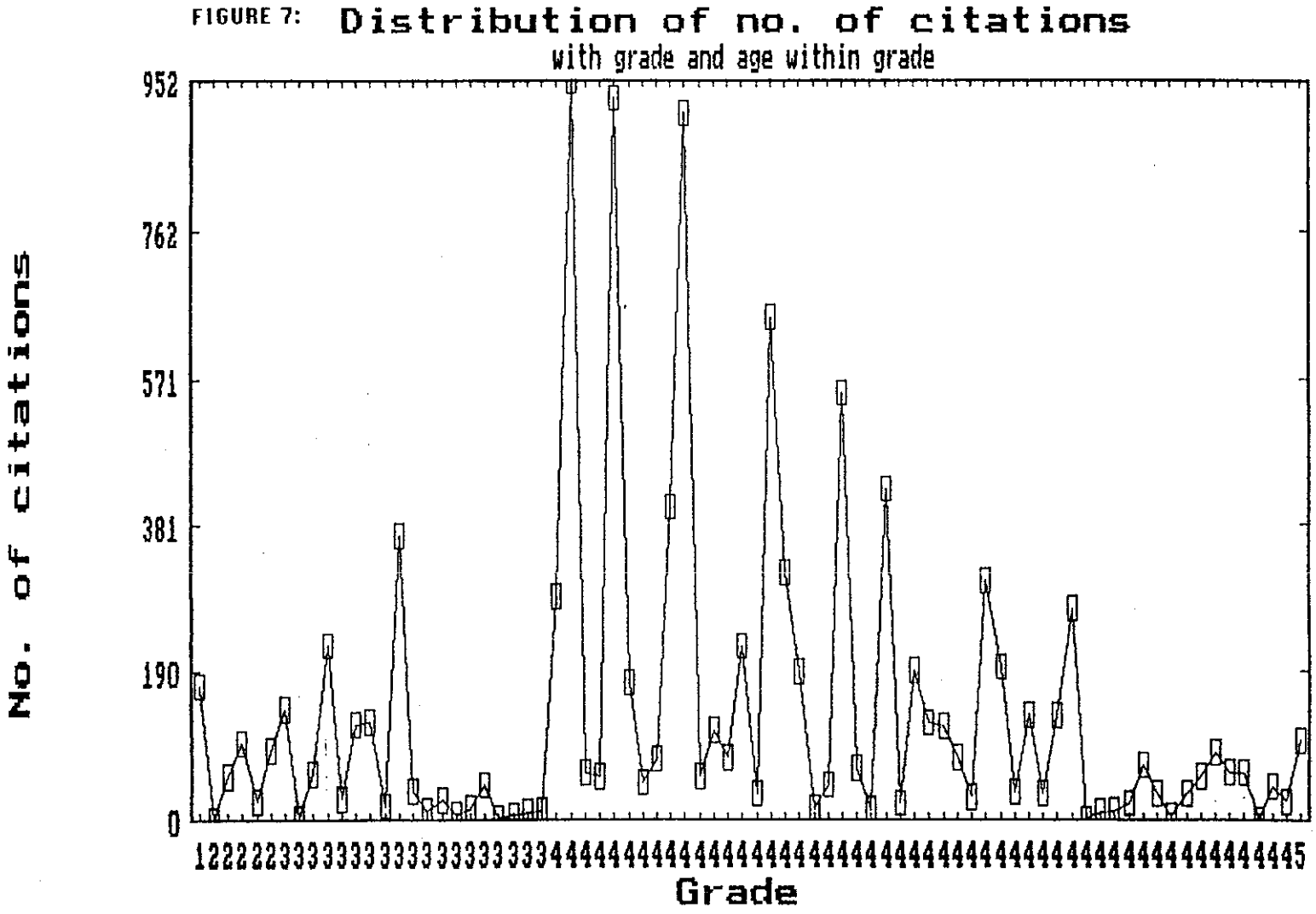

Distribution of no. of citations
with grade and age within grade
No. of citations
952
762
571
381
190
0
12222333333333333333344444444444444444444444444444444444444444444445
Grade

FIGURE 8: Distribution of citations/paper

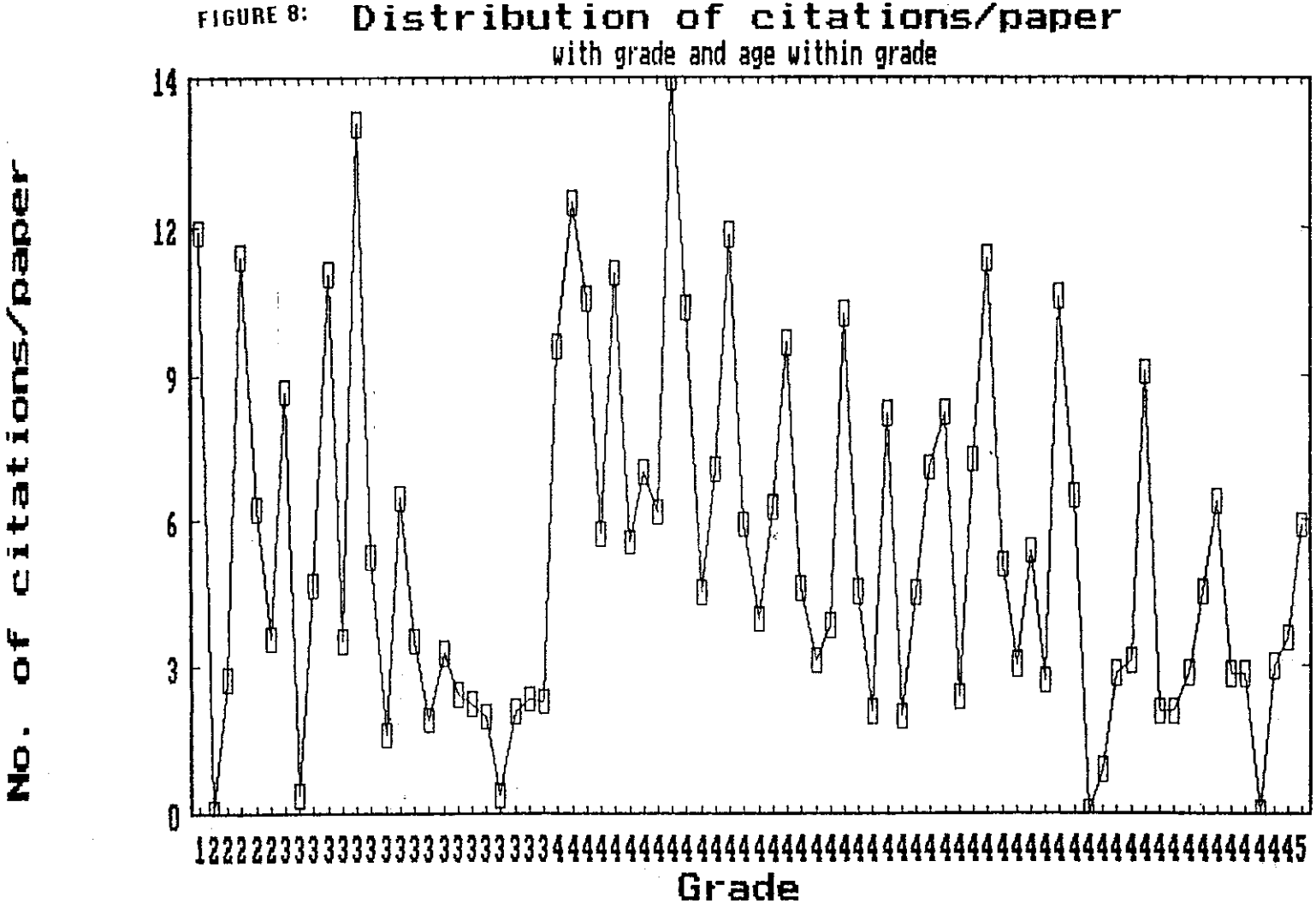
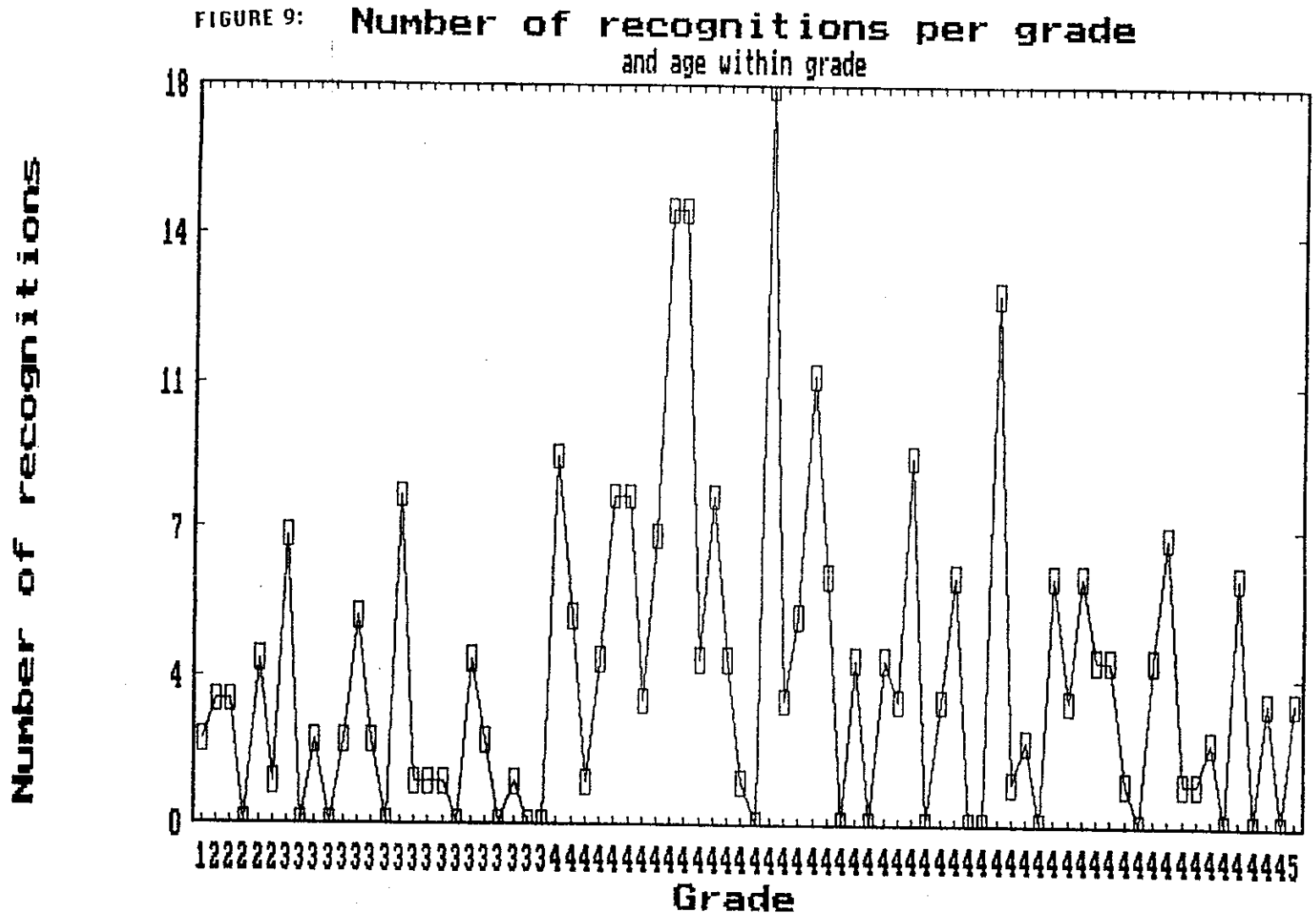


FIGURE 9:


Number of recognitions per grade
and age within grade
Number of recognitions
18
14
11
7
4
0
1222223333333333333333334444444444444444444444444444444444444444444444445
Grade

Evaluation Methodology for Research Productivity of Universities

E. Kehat, Y. Aharoni, D. Kohn, G. Czapski, E. Nissim, U. Rappaport

The objective of this exploratory study was to develop a methodology to estimate research productivity of academic units, which may be used also for disciplines where bibliometric data are not available.

For this purpose peer recognition items which may be integrated into a comprehensive number related to research productivity were tested on a limited scale.

The S. Neaman Institute
Technion City, Haifa 32000, Israel
Tel. 04-237145, Fax. 04-231889

ISBN No. 965-386-009-7