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ORGANIZATIONAL CONSENSUS REGARDING THE RELATIVE IMPORTANCE OF RESEARCH OUTPUT INDICATORS

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THESIS

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This work is dedicated to my mother and the memory of my father.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
FAC	Faculty
ADM	Administrators
CE	Civil Engineering Department
EE	Electrical Engineering Department
MIE	Mechanical and Industrial Engineering Department
DEPT	Departmental
COLL	College-level
CAMP	Campus-level
UNIV	University-level

Chapter I

INTRODUCTION

A. Research Objectives and Methodology

Recent years have seen efforts to identify, measure, and evaluate the outputs of higher education.[1] Since research is a mission of universities, there should be research output indicators to measure the attainment of this goal. In fact, a large number of indicators have been proposed and to some extent evaluated, though systematic measurement has hardly begun. By far the most concerted effort is carried on by the National Center for Higher Education Management Systems (NCHEMS) at the Western Interstate Commission for Higher Education (WICHE). NCHEMS has recently completed a large-scale Higher Education Outcome Measures Identification Study (OMIS).[2] With respect to the research mission of universities, only two of the fifteen proposed indicators--research proposals funded and research funding--were chosen for data acquisition based on the criterion of "need to know" of selected college and university administrators and state-level planners and legislators having responsibilities in the area of higher education.[3] While this result might appear satisfactory given the stated objectives of the OMIS and the interests of NCHEMS, it raised a number of questions deserving further research:

1. It is possible that the results of the OMIS were influenced by the perceptions and current practices of the survey participants. Furthermore, the survey was designed to reflect the points of view of high-level administrators and external interest groups; the views of faculty members and administrators at lower levels of the administrative hierarchy were not included. In this sense, the results obtained by OMIS were not representative of the evaluators and those evaluated.

2. Since nonfinancial indicators were found to be virtually unavailable to the survey respondents, it is possible that this would also affect the conclusion of the study. It is noteworthy that in the cases of research proposals funded and research funding, the respondents indicated some access and <u>also</u> a need to know. It is suggested that a survey of current perceptions and practices would not constitute an adequate basis for evaluating the <u>potential</u> usefulness of indicators of which there is little operational experience.

3. An examination of the OMIS proposal of research output indicators revealed an attempt to accommodate a variety of disciplines. Given the diverse ways of conveying knowledge outputs in many disciplines, it appeared infeasible to compile an all-inclusive list. Thus it was necessary to modify the list to recognize the requirements of the discipline or organization under study.

4. The Outcome Measures Identification Study was long on descriptive data but short on theoretical analysis. There was a need to conceptualize the indicators and articulate their relationships. Accounting theory offers little guidance in this respect; however, sociology and theories of organizational behavior would be instructive.

Based on these observations, the present study has the following objectives:

1. An attempt was made to balance the theoretical and empirical aspects of the study. Since exchange is implicit in the concept of output produced for a return, it serves as a basis of invoking social exchange theories to explain the existence of and relationships among research output indicators. Also since the exchanges take place in an organization context, theories of organizational behavior were also used to relate exchange with the concept of organizational effectiveness.

2. It was always implicitly assumed that output indicators might be useful in evaluating performance. However, the issue of the relative importance of these evaluative criteria has not been adequately addressed. This issue was viewed as an empirical one and therefore an opinion survey was conducted at a university to provide some evidence regarding the consensus among organizational members. In doing so, the objections of those theorists who dispute the propriety of attributing motivational

capability to social constructs such as organizations were avoided.[4] To carry the implications of the argument further, one should also be aware that not only do people have values, but that these values often differ, and this affects the social choice of evaluative criteria.

Thus a primary objective of the survey was to ascertain the extent of organizational consensus regarding the relative importance of research output indicators in evaluating the research effectiveness and reputation of three engineering departments at a university. In designing the survey, care was taken to include faculty and administrators at several levels of the university administrative structure. Also, the participants were requested to indicate their normative preferences--what they considered the case should be--regarding the relative importance of the indicators. Comparative analyses were made to ascertain possible differences in the preferences among faculty members of the three departments, and among faculty and administrators.

B. Overview of the Study[5]

Chapter II traces the development of accounting to a point where the performance measurement of not-for-profit organizations may be legitimately considered to lie within the scope of the discipline. This expansion in the scope of accounting coincided with the growing concerns and controversies of accountability in higher education. Since 1970 there have been several attempts to measure the outputs of higher education. These studies are reviewed in Chapter III with respect to research output indicators. In particular, the Higher Education Outcome Measures Identification Study (OMIS) by the National Center for Higher Education Management Systems (NCHEMS) assembled a relatively large number of research output indicators and concluded that only two funding related indicators deserved measurement implementation. The results of OMIS are analyzed and directions for further research are suggested.

Additional research is needed to provide a sound theoretical framework for the proposed indicators. Through the linkage of output to exchange, social exchange theories are invoked to provide the rationale for the proposed indicators, which in turn were adapted for the engineering departments at the university which served as the context for the empirical part of this study. Also in Chapter IV, Hagstrom's information-recognition exchange model of the scientific community is discussed as a precedent in viewing the dissemination of knowledge from an exchange perspective. However, it should be noted that Hagstrom considered research output indicators as communication channels, while in the present study they are regarded as criteria of organizational evaluation. The major contributions to the literature of social exchange are reviewed next. These include early anthropological studies of Frazer and Malinowski, later synthesis by Levi-Strauss, and more recent works of Homans, Gouldner, and Blau. Though diverse in methodology and substance, they all dealt with three basic issues: the motives of exchange, the structure of reciprocity, and the valuation of exchange items.

In Chapter V, these three issues are raised with regard to the research output indicators. The need for *distinguishing two types of research output indicators* is also recognized. Knowledge-related indicators are closer to the substantive knowledge products than recognition-related indicators, which are the results of evaluations of the contributions to knowledge. Based on this distinction, a flow model of the indicators is proposed. In academic research, there are economic and social motivations as well as intellectual stimulation. These motivations are reinforced by the complex processes of reciprocity. The analytic scheme of Levi-Strauss is expanded to be a network of diffusion and feedback of research output indicators. It is further noted that economic valuation is partially replaced by institutionalized peer evaluations of research, which provide recognition commensurate with the degree of contribution to knowledge. Lastly, Merton's application of the Mathew effect to the social system of science is used to link outputs to the generation of input resources needed for research, thus completing an open-systems model similar to that of Katz and Kahn.

Chapter VI explains the rationale and the procedure of a questionnaire survey used to ascertain the extent of organization consensus regarding the relative importance of research output indicators in evaluating the research effectiveness and reputation of three engineering departments. The need to investigate the value preferences of organizational members is discussed with reference to recent criticisms of the goal paradigm. The survey sought to find the normative preferences of faculty members and administrators by asking them to rank order the knowledge and recognition indicators separately. The ordinal data were analyzed by the nonparametric Kruskal-Wallis analysis of variance to ascertain possible differences with respect to group means among faculty and administrator groups. Parametric ANOVA were then made to assess the effects of the violation of the large sample assumption in the Kruskal-Wallis test. In case differences were found at the 0.10 significance level in the Kruskal-Wallis test. Dunn's multiple comparisons were used to ascertain the source of difference. Because the large sample assumption was violated, the Dunn test was only partially successful. However, by analyzing the intermediary statistics, a detailed picture of the pattern of consensus, or lack of it, could still be obtained. The study reached the conclusion that there was a high level of consensus that published articles were the most important knowledge-related indicator and peer judgment of research results the most important recognition indicator. The limitations and implication of the present study are stated in the concluding chapter.

Footnotes for Chapter I

[1]See Chapter III.

[2]See Chapter III, Section C.

[3]See Chapter III, Section C.

[4]See Chapter VI, Section B.

[5]For citations of references, see the respective chapters.

Chapter II

CHANGING OBJECTIVES OF ACCOUNTING

Objectives of accounting have undergone significant changes in recent decades. This is evidenced by a series of statements concerning what accounting is or should be. One of the earliest attempts was made in 1941 by the Committee on Terminology of the American Institute of Certified Public Accountants (AICPA). The committee considered accounting to be

> the art of recording, classifying, and summarizing in a significant manner and in terms of money, transactions and events which are, in part at least, of a financial character, and interpreting the results thereof.[1]

The essence of this definition of accounting was present in a number of subsequent statements. Notably the Committee to Prepare a Statement of Basic Accounting Theory (ASOBAT) of the American Accounting Association (AAA) defined accounting as

> the process of identifying, measuring, and communicating economic information to permit informed judgments and decisions of users of the information.[2]

With the exception of explicitly relating accounting information to its users, this definition appears rather traditional. However, one should not overlook the rather expansive tendency of ASOBAT in projecting the scope of the accounting discipline. Namely, "[m]easurement and communication of data revealing past, present, and prospective socio-economic activities" were considered to be an objective of the accounting function.[3] Indeed the social dimension of accounting was formally incorporated into a definition of accounting authored by Langenderfer in 1973:

> Accounting is a measurement and communication system to provide economic and social information about an identifiable entity to permit users to make informed judgments and decisions leading to an optimum allocation of resources and accomplishments of the organization's objectives.[4]

Also notable in the Langenderfer definition is its specific reference to the objectives of the accounting entity. This theme was also expressed by the Study Group on the Objectives of Financial Statements of the AICPA:

> An objective of financial statements for governmental and not-for-profit organizations is to provide information useful for evaluating the effectiveness of the management of resources in achieving the organization's goals. Performance measures should be quantified in terms of identified goals.[5]

Certainly there are other statements of the objectives of accounting. However, those quoted above appear to capture the evolutionary trends of the accounting discipline. First, there has been a definite expansion of the scope of accounting. Accounting for social and future activities is now considered to be legitimate, at least from a theoretical standpoint. The chronological development of accounting may be represented by the path in the following diagram (Figure 1).

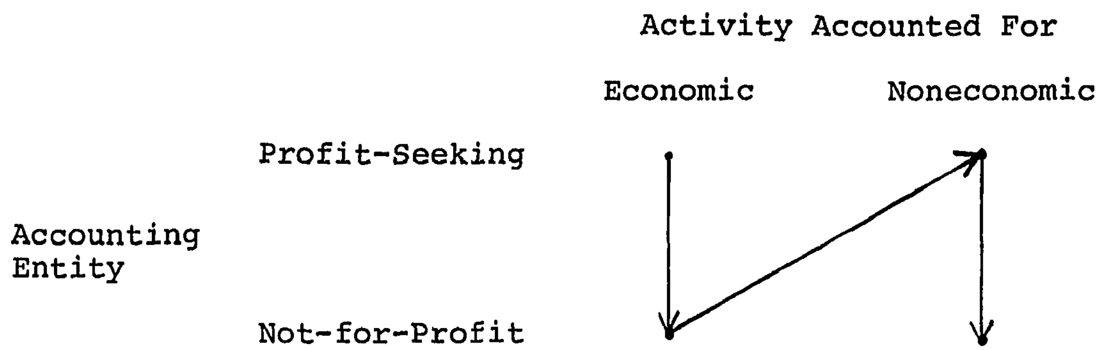

Figure 1. Stages in the Development of Accounting

Second, the traditional view of accounting as a service function is reinforced. Not only is accounting charged to be responsive to users' needs, accounting information is also considered to be an instrument of organizational evaluation of goal achievement. In accounting for economic activities of profit-seeking entities, profit serves as a conventional criterion of evaluation. Even in accounting for the economic activities of not-for-profit entities, there are criteria based on the comparison of economic benefits and costs. However, in accounting for noneconomic aspects of the operations of both profit-seeking and not-for-profit entities, economic criteria become less, if at all, valid. The reasons were pointed out by the Study Group on the Objectives of Financial Statements as follows:

> Since the goals of governmental and not-for-profit institutions are primarily nonmonetary, the indicators of earning power in commercial enterprises have limited values for assessing their performance. Most useful indicators are those based on the not-for-profit organization's principal goals, . . . But these are more difficult to measure and communicate in monetary terms, because the goals themselves are qualitative, not monetary. Goals vary widely and, when identified, are frequently difficult to measure. Useful measures of performance of one organization may be meaningless for another. Still, performance of each must be measured.[6]

The study group's statement reflects a dilemma facing accounting for not-for-profit organizations: the goal paradigm, which serves the business sector so well, especially when it is reduced to the sole dimension of profitability, become less potent in situations where goals are diverse and qualitative. Yet the study group still advised accountants to rely on the goal paradigm. A particular manifestation of this dilemma occurs in the higher education sector, where the call for accountability is translated by some proponents into an insistence on measurable benefits and costs. This area has received relatively little attention from the accounting profession. The present inquiry attempts to address this situation by considering specifically the performance measures of academic research. The next chapter surveys the current status of research and practice in this area and points out the need for further research.

Footnotes for Chapter II

[1]American Institute of Certified Public Accountants, Committee on Terminology, Accounting Terminology Bulletin, No.1 (New York: AICPA, 1953), p. 3.

[2]American Accounting Association, Committee to Prepare a Statement of Basic Accounting Theory, A Statement of Basic Accounting Theory (Evanston, Illinois: AAA, 1966), p. 1.

[3]Ibid., p. 68.

[4]Harold Q. Langenderfer, "A Conceptual Framework for Financial Accounting," The Journal of Accountancy 136 (July 1973): 50.

[5]American Institute of Certified Public Accountants, Study Group on the Objectives of Financial Statements, Objectives of Financial Statements (New York: AICPA, 1973), p. 66.

[6]Ibid., p. 50.

Chapter III

STUDIES TO IDENTIFY UNIVERSITY RESEARCH OUTPUT INDICATORS

This chapter surveys studies parts of which dealt with the research goals and outputs of universities. The infancy of research in this area was revealed by the lack of specificity of the research goals of universities in the Gross and Gramsch study. Following the impetus provided by a joint effort of several agencies, research on academic research accelerated. The remainder of the chapter will be devoted to a review of the initial collective effort in 1970 and a detailed analysis of the Higher Education Outcome Measures Identification Study (OMIS) conducted by the National Center for Higher Education Management Systems (NCHEMS).

A. The Gross-Gramsch Study (1968)

When Gross and Gramsch studied university goals in the late 1960s, they mentioned two research output goals of universities--"Carry on pure research," and "Carry on applied research."[1] When compared with other output goals of universities, the proposed research output goals were few and lacked specificity and substantiveness. However, the Gross-Gramsch study is instructive to the present study in a number of ways:

1. It may be inferred from the Gross-Gramsch study that serious study of university research output indicators had scarcely started in the late 1960s.

2. Gross and Gramsch asked each questionnaire respondent to indicate, on a five-point scale, (a) "just how much emphasis he felt a given goal [actually] received at his institution," and (b) "how much emphasis he felt it should receive." From the responses, they arrived at two sets of ranks of the goals, which they referred to as perceived and preferred goal structures.[2]

This distinction between perceived and preferred importance influenced the emphasis on normative preferences in the present study. The reasons for this choice were: (a) Differences between responses regarding actual importance could in part be a function of the respondent's degree of factual knowledge. When the presumption of factual knowledge was unsound, the indications of actual importance would be difficult to interpret. (b) The present state of affairs is often the result of implementing some past preferences. In this sense, normative preferences are fundamental and influential in determining the weights of evaluative criteria.

3. Gross and Gramsch solicited the views of administrators and faculty members with the intention of testing "the validity of the common assertion that faculty and administrators have different points of view and different values and that therefore the decision-making power of a central

administration is an inimical influence on the university."[3] Furthermore, they studied the goal preferences of administrators of different ranks.[4]

Since their specific findings are only tangential to the present study, it would be beneficial to know their overall conclusions: (a) With respect to perceived goals, faculty and administrators "agree in their views of the relative emphasis placed on 34 of the 47 goals." Where they differed, the differences were considered to be insignificant. The comparison of administrators at various ranks also resulted in essentially the same finding.[5] (b) With respect to preferred goals, again general agreement prevailed. The authors emphasized that "the few differences that exist in the values and attitudes of administrators and faculty, are too slight to warrant any inference of deep-seated conflict. . . . They value and work toward essentially the same goals. In short, the power of administrators does not seem to jeopardize the interests of the faculty."[6]

The present inquiry is not a replication of the Gross-Gramsch study; however, it would be of interest to ascertain if the general pattern of agreement between faculty and administrators would hold in the context of this study, which specializes on the research output goals.

B. A Collective Effort (1970)

Research outputs are a subset of outputs of higher education--a type that was relatively neglected in attempts to identify, measure, and evaluate the larger set of outputs. Current interests in the outputs of higher education are due more to the controversial demands for accountability than to academic curiosity. This theme was pervasive in a seminar on outputs of higher education conducted by the Western Interstate Commission for Higher Education in cooperation with the American Council on Education and the Center for Research and Development in Higher Education at the University of California at Berkeley. At the conclusion of the seminar, a tentative list of output indicators including some for research goals was compiled. The research output indicators and their sources are quoted in Table 1.

TABLE 1

RESEARCH OUTPUTS PROPOSED IN 1970[8]

Research Outputs	
Variables	Source of Measures
Reorganization of Knowledge	Number of new books, text-books, etc.
New Inventions and Development (Applied Research Products)	Number of patents, adopted procedures, etc.
New Ideas and Concepts (Pure Research Outputs)	Number of articles, papers, awards, citations, etc.
Personal Involvement of Students and Others (instructional spinoff)	Number of hours [of] involvement by students, industry, personnel, etc.

When compared with the mere mentioning of two unsubstantiated research output goals by Gross and Gramsch, the proposed list in Table 1 was a step forward in the right direction. However, there were a number of problems: (a) While the procedure of first identifying the variables and then attempting to find their empirical indicators was a sound one, the proposed scheme failed to differentiate several levels of output surrogates. For example, it would require some stretch of the imagination to classify awards and citations along with articles and papers as the sources of new ideas and concepts. It would be desirable to have a framework for organizing these indicators. (b) It would seem that personal involvement in research is an input. To consider it as an output would require some rationalization and justification. (c) The distinction between pure and applied research is a difficult one. The proposed sources of measures for pure research could easily be those for applied research, or vice versa. The lack of mutual exclusiveness renders the classification rather unsatisfactory.

To some extent a number of these problems were alleviated in a subsequent study by the National Center for Higher Education Management Systems (NCHEMS), which is described in the next section.

C. The NCHEMS Higher Education Outcome Measures Identification Study (1974-1975)

Objectives

The objectives of the NCHEMS Higher Education Outcome Measures Identification Study (OMIS) were:

1. To learn what outcome information different decision makers need for their decision-making responsibilities.

2. To learn what outcome information currently is available to them.

3. To identify a high priority list of outcome measures for which data acquisition procedures need to be developed.[9]

Procedures

The Outcome Measures Identification Study was preceded by a preliminary study in which an "Inventory of Higher Education Outcome Variables and Measures" was developed.[10] The OMIS itself consisted of two phases: a pilot test and a full-scale survey. The full-scale survey will be summarized and critiqued in this section with reference to the research area only. The survey made use of a lengthy questionnaire which was sent to a sample of college administrators and state-level decision makers having responsibilities in the area of higher education.[11] Since the identity of the participants could conceivably have a bearing to the results of the survey, it is worthwhile to take a close look at the sample composition and the response rate. The data are presented in Table 2.

Output Areas and Research Output Indicators

The Outcome Measures Identification Study arrived at ten categories of "outcome areas." Although the term "research" was not specifically used, the category of "development of new knowledge and art" corresponded to it. The ten areas and the number of specific measures in each are presented in Table 3.

TABLE 2

SAMPLE COMPOSITION AND RESPONSE RATE IN THE NCHEMS OUTCOME MEASURES IDENTIFICATION STUDY[12]

Participants	Number of Respondents	Response Rate
Presidents	97	54%
Top administrators for academic affairs	97	53%
Top administrators for student affairs	97	67%
Top administrators for budget & finance	97	67%
Total college and university administrators	388	61%
State-wide planners	75	68%
State legislators	50	26%
Total state-level decision makers	125	51%

TABLE 3

OUTPUT AREAS IDENTIFIED BY THE OMIS[13]

	Areas	Number of Measures
A.	Student knowledge and skills development . .	10
B.	Student educational career development . . .	14
C.	Student educational satisfaction	8
D.	Student occupational career development . .	13
E.	Student personal development	7
F.	Student social/cultural development	16
G.	Community educational development	6
H.	Community service	7
I.	Community impact	16
J.	Development of new knowledge and art	15

The fifteen specific measures in "development of new knowledge and art" are abstracted as follows:[14]

1. Publication by type
2. Citations
3. Articles in prestigious journals
4. Papers presented
5. Awards and citations received
6. Faculty time devoted to research
7. Research proposals funded
8. Dollar amount of research gifts and grants
9. Faculty involved in instructional technology
10. Patents and copyrights
11. Commercially published books and monographs
12. Judgments of peer and beneficiary groups on research
13. Graduates engaged in research
14. Invitations received to participate in professional conferences
15. Graduates with artistic creations

This list certainly was an expansion of the 1970 scheme. It reflected an attempt to cover a wide range of disciplines. It is doubtful that a complete list could ever be compiled given the variety of disciplines and diverse ways in which knowledge is disseminated. It would therefore appear reasonable to view this and other lists as points of departure for specific lists modified to suit the needs of particular disciplines or organizations. Thus in a subsequent section, this list will be modified to accommodate the engineering departments which served the context of the empirical phase of the study.

Interpretations of Results

The Outcome Measures Identification Study generated a wealth of descriptive data. This analysis will cover only a portion of the data dealing with research in higher education. In particular, the issues of need to know and accessibility will be examined.

1. Survey participants were asked how important it was for them to have information regarding the ten outcome areas in view of their decision-making responsibilities. Research was at the bottom of the list in terms of mean importance score (Table 4).[15]

TABLE 4

COMPARATIVE IMPORTANCE OF RESEARCH AREA FOUND IN THE OMIS[16]

	Respondent	
	College	State-level
Mean importance score out of a maximum of five points	3.38	3.32
Rank among ten outcome areas	9	8

In interpreting this result, one should be keenly aware that only the respondents' actual perceptions were sought. The OMIS did not address the question as to whether these decision makers <u>should</u> need a particular type of information, nor was this normative question posed to the survey participants.

2. While both college administrators and state-level decision makers downplayed the importance of output information on research for their responsibilities, there were marked variations among college administrators (Table 5).[17]

TABLE 5

IMPORTANCE OF THE RESEARCH AREA ATTRIBUTED BY COLLEGE AND UNIVERSITY ADMINISTRATORS IN THE OMIS[18]

College and University Administrators	Mean Importance Score	Rank
Presidents	3.50	9
Academic affairs	3.71	5
Student affairs	3.29	10
Budget and finance	3.30	4

It may be observed that only administrators of academic affairs, and of budget and finance regarded research outcome information as relatively and moderately important. This is not surprising because research is a faculty and graduate student activity, and therefore lies within the responsibilities of academic affairs administrators. Budget and finance administrators are involved in the funding aspect of research and hence attributed some importance to information on research. By the same reasoning, academic affairs administrators as a group had the largest percentage of respondents indicating a need to know most research output indicators. But even in this group, the highest percentage, as in the case of research proposals funded, was not more than 56%.[19]

3. Only three research outcome measures were among the top twenty items endorsed as most needed by <u>any</u> of the different groups of respondents. These were research proposals funded, research funding, and books and monographs commercially published.[20] The selection of the first two indicators is understandable in terms of the respondents' responsibilities. But then it would take some justification to regard them as output indicators. Thus books and monographs became the sole output indicator selected. Since they are not a primary and timely medium for disseminating research results, this choice appears lacking rational justification.

4. With the exceptions of research proposals funded and research funding, in all groups of college and university administrators the percentage of respondents indicating "Don't Have Access" was greater than that for "Have Access." The sole exception to this situation was that for commercially published books and monographs in the case of academic affairs administrators.[21] Thus the evidence overwhelmingly suggested that nonfinancial research output measures were unavailable even to administrators.

Implications

A direct consequence of the NCHEMS Outcome Measures Identification Study was that in the next phase of the NCHEMS project, only research proposals funded and research restricted revenue were considered for actual data acquisition.[22] However, this does not mean that research output indicators are completely useless. Actually, it was found that some output indicators were already extensively and fruitfully used even before the NCHEMS effort. A classic example is the work of Price, an historian of science who used the number of scientific journals and papers to ascertain the pattern of growth of science.[23] More recently the availability of the Science Citation Index has enabled researchers to test propositions concerning science as a social system. For instance, the Cole brothers, who are sociologists of science, used it to investigate the stratification among physicists.[24] It is conceivable that research output indicators could have other uses. Since they are a type of performance measure, it seems reasonable to link them with the evaluation of research activities of, say, academic departments.

There are other implications which would necessitate further research:

1. Faculty members and administrators at lower levels of the university administrative hierarchy were not

included in the OMIS. These people are often researchers themselves or research administrators, and their views should be taken into consideration.

2. In view of the general lack of availability of nonfinancial output indicators, it is conceivable that the responses obtained in the NCHEMS study were constrained by the respondents' inadequate factual knowledge. In a case like this, the normative question of what should be made available to the decision makers would seem more appropriate.

3. It may be hypothesized that research output indicators are discipline-specific; that is, each discipline may have its own set of output indicators. Therefore it would be necessary to modify a general list, such as the one proposed by NCHEMS, to suit the characteristics of particular disciplines or academic organizations under study.

4. The NCHEMS Outcome Measures Identification Study was essentially an opinion survey and did not develop a conceptual framework to articulate the large number of measures proposed. In the present study, social exchange theories are proposed as a possible theoretical framework to explain the existence and operations of research output indicators. Furthermore, these indicators would be used as criteria for evaluating organizational effectiveness and reputation in conducting research.

Footnotes for Chapter III

[1]Edward Gross and Paul V. Gramsch, University Goals & Academic Power (Washington, D.C.: American Council on Education, 1968), p. 119.

[2]Ibid., p. 108.

[3]Ibid., p. 107.

[4]Ibid., p. 104.

[5]Ibid., pp. 101-2.

[6]Ibid., p. 105.

[7]Ben Lawrence, George Weathersby, and Virginia W. Patterson, eds., Outputs of Higher Education: Their Identification, Measurement, and Evaluation (Boulder, Colo.: Western Interstate Commission for Higher Education, 1970).

[8]Ibid., p. 113.

[9]Sidney S. Micek and William Ray Arney, The Higher Education Outcome Measures Identification Study: A Descriptive Summary (Boulder, Colo.: National Center for Higher Education Management Systems, 1974), p. 2.

[10]Sidney S. Micek and Robert A. Wallhaus, An Introduction to the Identification and Uses of Higher Education Outcome Information (Boulder, Colo.: Western Interstate Commission for Higher Education, 1973).

[11]Micek and Arney, Outcome Measures Identification, pp. 6-7.

[12]Data derived from Ibid., pp. 4, 7-8.

[13]Abstracted from Ibid., Table 2, p. 13.

[14]Abstracted from Ibid., Table 3, pp. 24-26.

[15]Ibid., p. 11.

[16]Data abstracted and derived from Ibid., Table 1, p. 11.

[17]Ibid., p. 13.

[18]Data abstracted and derived from Ibid., Table 2, p. 13.

[19]Ibid., Table 3, p. 25.

[20]Ibid., p. 32.

[21]Ibid., pp. 104-5.

[22]Sidney S. Micek, Allan L. Service, and Yong S. Lee, Outcome Measures and Procedure Manual, Field Ed. (Boulder, Colo.: National Center for Higher Education Management Systems, 1975), pp. 157-163.

[23]Derek J. de Solla Price, Little Science, Big Science (New York: Columbia University Press, 1963).

[24]Jonathan Cole and Stephen Cole, Social Stratification in Science (Chicago: University of Chicago Press, 1973).

Chapter IV

SOCIAL EXCHANGE THEORIES

A. Introduction

The outputs of an entity are what it produces and distributes to its environment. Unless the distribution is an unilateral benefaction, typically there is an exchange of benefits. For instance, since institutions of higher education are not given resources free of obligations, they are called upon to demonstrate the benefits generated wholly or partly by the resources endowed. One type of benefits a university produces is knowledge--the results of research activities. Knowledge is embodied in outputs of research, which are selectively disseminated partly to parties outside of the university. Researchers in return receive resource supports and symbolic recognitions. The concept of exchange encompasses the flows in both directions. Indeed, the Hagstrom study fruitfully used the concept to formulate an information-recognition exchange model of the scientific community.[1] The next section recognizes Hagstrom's contribution and the need for a more general model of exchange for formal organizations.

B. Hagstrom's Information-Recognition Exchange Model

As was noted earlier, the Outcome Measures Identification Study was weak in that it did not provide a theoretical framework for interpreting the proposed indicators. A possibly useful, though limited, framework already existed in the work of Hagstrom, who investigated the informal organization of the basic sciences. Hagstrom's thesis was that "social control in science is exercised in an exchange system, a system wherein gifts of information are exchanged for recognition from scientific colleagues."[2] The rationale for this thesis was that, by postulating the scientists' desire for social recognition, the awarding or withholding of social recognition would induce the scientists to conform to the norms of the scientific community.[3] By recognition, Hagstrom meant "the written and verbal behavior and the 'expressive gestures' of scientists that indicate their approval and esteem of a colleague because of his research accomplishments."[4] Hagstrom drew some instructive distinctions between elementary recognition and institutionalized recognition: elementary recognition is expressed in direct communication among individual scientists, and institutionalized recognition is given through the formal channels of communication in science.[5]

Hagstrom identified the following as examples of formal channels of communication in science:[6]

1. Articles in scientific journals
2. Books
3. Papers read at public meetings
4. Footnote citations to specific articles and acknowledgments
5. Collective honors, such as prizes and medals, invited lectures, collections of papers in honor of distinguished scientists, and review articles by leading scientists
6. Invitations to do prepublication review of articles

Virtually all of the above channels were included in the list proposed by the NCHEMS Outcome Measures Identification Study. But it is significant that they could, and were, explained by the information-recognition exchange model. Hagstrom's model is an application of the more general concept of exchange to a particular area. His model is restricted to the informal social control of a segment of the scientific community. One should extend the inquiry to the fundamental processes of exchange and draw some implications from them. Accounting has long been dependent upon economic exchange processes to generate original data. A broadened view of accounting to the social sphere would also need a generalized concept of exchange to encompass both material and symbolic exchanges. Thus in the next section the literature of social exchange theories is reviewed.

C. Social Exchange Theories

Introduction

The objective of this section is to review the major contributions to social exchange theories in the hope of obtaining some useful concepts and theoretical perspectives to guide the conceptualization of research output indicators. These contributions are diverse in methodology, content, and scope. Some are specific anthropological case studies; others are theorizations. Some deal with behaviors in primitive societies; others address themselves to contemporary Western societies. Some study particular types of exchange; others are quite encompassing. Since only the concepts and theories in these contributions are of primary interest to the present study, the essence of each contribution is abstracted. Ekeh provides a good analysis for readers who are interested in the polemics among writers in this area.[7]

Anthropological case studies in the first quarter of this century provided fertile grounds for subsequent theoretical developments. These case studies were about the exchange behaviors of non-Western primitive societies. Frazer (1919) studied kinship and marriage behaviors of Australian aborigines.[8] Malinowski (1922) observed the Kula exchange of necklaces and armshells among the Trobriand Islanders of the South Pacific.[9] Though Malinowski, in contrast to Frazer, did impute social and psychological motives to the Kula exchange, he was criticized by Mauss for tending to overemphasize the latter.[10] Frazer's utilitarian interpretations of social exchange were disputed by Levi-Strauss, who provided a relatively comprehensive statement of social exchange.[11] While Homans and Blau broadened the anthropologists' exchange items to include intangible items, their contributions were limited for other reasons. Homans' exchanges were more restricted than Levi-Strauss'; also his attempt to reduce human behavior to behavioral psychology was criticized. Blau's utilitarian interpretation of social exchange had been anticipated by Frazer long ago.[12]

Early Anthropological Studies

Frazer was credited for having offered the first theory of social exchange, on the basis of his economic interpretation of the prevalence of cross-cousin marriage among the Australian aborigines.[13] Transcending the particular exchange items and context, Frazer's contributions were seminal. He imputed utilitarian economic values to the exchange items. Furthermore, he observed that social exchange processes were motivated by the economic needs of the popululation, and exploited by individuals to gain power and prestige. Besides, social institutions were set up to facilitate the exchange.[14]

Malinowski's social exchange theory was also grounded on his observations of a phenomenon in a primitive non-Western society. Noting the nonutilitarian nature of the Kula exchange of armshells and necklaces, Malinowski was led to make a distinction between economic and social (symbolic) exchanges. He felt that the Kula exchange was conducted to satisfy social and psychological needs, rather than for economic reasons. He also perceived the role of exchange relations in inducing social differentiation and solidarity, since the exchange, while conducted by a pair of actors, was part of a social network.[15]

Malinowski's functionalism was criticized by later authors such as sociologist Merton.[16] His early critic, however, was Mauss who stressed that the actors in an exchange were performing their social roles. Mauss was also notable for his recognition that exchanges gave rise to and simultaneously reinforced the normative structure of the society.[17]

The Contribution of Levi-Strauss

Thirty years after Frazer's utilitarian interpretation of social exchange, Levi-Strauss undertook a searching examination of the cross-cousin marriage phenomenon and gave a comparatively comprehensive version of social exchange theory. Levi-Strauss' work was critiqued and elaborated by Ekeh in 1974.[18] Only the briefest summary of their effort is possible here.

Levi-Strauss emphasized the cultural meaning of social exchange items and attributed greater weight to their symbolic extrinsic value than to their economic intrisic value. In addition, he stressed that social exchange was a human activity, and the behavior of subhuman animals would therefore be incapable of providing a model of human exchange. Levi-Strauss' most significant contribution was his discussion of the institutional basis of social exchange and the structure of reciprocity in exchange. He traced the necessity of social norms to regulate the distribution and exchange of exchange items to the social scarcity of these items. He also attributed the cost of social exchange to the social norms governing the exchange. Moreover, he felt that exploitation should not occur in exchange; if it did, it would endanger the viability of the process, for he considered social exchange as performing an integrative role in society, both structurally and functionally. While Frazer and Malinowski dealt with exchanges involving two parties, Levi-Strauss' system, as supplemented by Ekeh, was substantially more elaborate (Figure 2).

As Figure 2 shows, there are two types of exchanges--restricted and generalized.[20] The basic unit in a restricted exchange is a pair, and mutual reciprocity is the guiding principle. An exclusive restricted exchange is conducted by isolated pairs, while inclusive restricted exchange is a network of multiple exclusive restricted exchanges. When there are three or more parties to an exchange, it is characterized as a generalized exchange operating on the principle of univocal or directional reciprocity among the actors who benefit each other indirectly. There are two types of generalized exchanges--chain and net:

a. In a chain generalized exchange, the actors are so situated that each is benefited sequentially. For example, if there are five members in the chain and the arrow means "gives to," the chain reciprocity may be shown in this way: A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ D $\rightarrow$ E $\rightarrow$ A.

b. There are two types of net generalized exchange--the individual-focused and group-focused. In the former, each member receives benefit from the rest of the group consecutively; for example, ABCD $\rightarrow$ E, ABCE $\rightarrow$ D, ABDE $\rightarrow$ C, ACDE $\rightarrow$ B, and BCDE $\rightarrow$ A. In the group-focused situation, the members successively contribute to the group and then gain back as one of the recipient subgroup; for example, A $\rightarrow$ BCDE, B $\rightarrow$ ACDE, C $\rightarrow$ ABDE, D $\rightarrow$ ABCE, and E $\rightarrow$ ABCD.

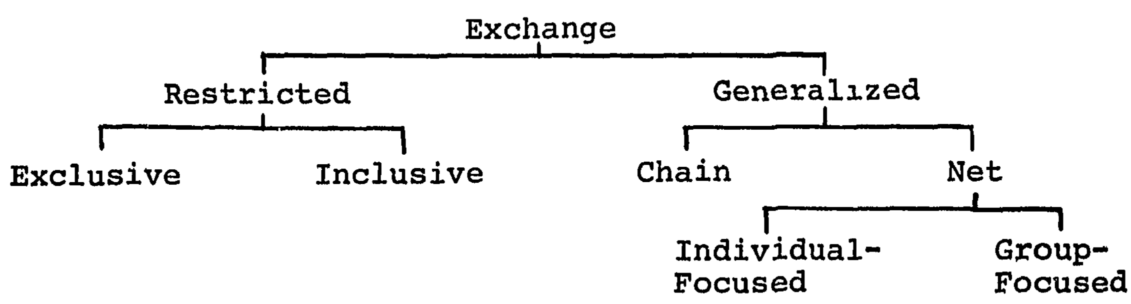

Figure 2. Levi-Strauss' Typology of Exchanges[19]

The Contributions of Homans and Blau

Sociologist Homans expanded the specialized exchange items in the theories of Frazer, Malinowski, and Levi-Strauss to include a range of tangible and intangible items. He also attempted to exhaustively explain human social exchange behavior in terms of conditioned behavior common to animals and human beings. This psychological reductionism approach has been controversial. Other than these innovations, Homans' exchange theory was not as sophisticated as that of Levi-Strauss. It dealt with face-to-face direct relations between two parties, with an emphasis on both the psychological and economic needs of the exchange participants, and on the utilitarian values of exchange items.[21]

Another major contributor to social exchange theory is Blau, whose strategy was to build complex and indirect processes on the basis of simple and direct ones. Utilitarian thinking permeated his whole work and would be best illustrated by his definition of social exchange as "actions that are contingent on rewarding reactions from others and that cease when these expected reactions are not forthcoming."[22] Thus social exchange is characterized by double contingency and is a trial-and-error process threatened by uncertain reciprocity.[23]

When an exchange occurs between macrostructures, as contrasted with that between persons, personal attraction would be replaced by shared values. At this level, values and norms are institutionalized and perpetuated, and value consensus provides a mechanism which mediates indirect exchanges. Blau mentioned four types of social values:[24]

a. Particularistic values as media of solidarity

b. Universalistic values as media of exchange and differentiation

c. Legitimating values as media of organization

d. Opposition ideals as media of reorganization

Universalistic values serve the role of media of exchange because they provide standards for setting the relative values of exchange items and performance, and allow the diverse contributions to collective welfare to be converted into differential social statuses. Thus high social status is a social acknowledgment of contributions and can benefit those who possess it. The universality of values assumes prominence in indirect exchanges because it makes it possible for persons to render service to some and receive rewards from others. In these ways, universalistic values in social exchanges serve the function of money in economic exchanges.[25]

On the whole, Blau's utilitarianism, which was foreshadowed by that of Frazer, blurred the distinction between economic and social exchanges. Nevertheless he did observe a number of differences between the two types of exchanges:

1. Economic exchanges gave rise to contractual obligations, and social exchanges engendered moral obligations.
2. Correlatively, social benefits were less detached from their sources of supply than economic benefits would be.
3. Economic exchanges were facilitated by money as a single medium of transactions, and social exchanges were lacking in this respect, though as explained earlier, universalistic values performed a similar function.[26]

Gouldner on Reciprocity

Homans and Blau have been identified as two major contributors to social exchange theories. It would be evident from the analysis thus far that they stood on the shoulders of some other giants. It would only be fair to trace the intellectual debt and give credit where it is due. In this regard, the central idea of mutual contingency identified previously with Blau should be linked with names such as Parsons and Gouldner. Gouldner's elucidation of the concept of reciprocity was carried out in the pretext of pointing out a hidden assumption in functional analysis as examplified by Parsons. His chief criticism was that the functional approach did not make the concept of reciprocity explicit.[27] In the words of one of its chief proponents, functionalism interprets data "by establishing their consequences for larger structures in which they are implicated."[28] Gouldner wished that the functionalist would make explicit analysis of the feedback from the larger structure.[29] The main target of his criticism was Parsons, who alledgedly failed to make a distinction between complementarity and reciprocity. This was in spite of Parsons' recognition of "a double contingency inherent in interaction."[30] "Complementarity," said Gouldner, "connotes that one's rights are another's obligation, and *vice versa*. Reciprocity, however, connotes that *each* party has rights *and* duties."[31] Gouldner considered internalized general moral norms of reciprocity as the starting mechanism for an exchange even when the specific terms of reciprocity had not been set. In another way, the norm of reciprocity would also stabilize social systems by rewarding conformity and discouraging deviance, as recognized in functional theory.[32] In terms of intellectual lineage, then, Blau built upon the achievements of Parsons and Gouldner.

D. Reconciling Exchange and Functional Theories

Gouldner criticized the functional approach for failing to explicitly consider the feedback from the larger structure to the object of inquiry which produced the consequences. This criticism has been weakened by the incorporation of what Stinchcombe called "reverse causal processes" into a functional explanation.[33] It appears reasonable to equate reverse causal processes with feedback to the extent that the feedback influences the behavior whose consequences induced the feedback. By this line of reasoning, then, exchange becomes a part of the functional explanation. On the other hand, when reciprocity is contingent upon the consequences of some prior action, the essence of the functional explanation may be considered to be a part of the exchange perspective. These clarifications would bring about a reconciliation between exchange and functional theories. For the purposes of this study, exchange theories are considered to be a major theoretical perspective which includes the functional point of view.

Footnotes for Chapter IV

[1]Warren O. Hagstrom, The Scientific Community (New York: Basic Books, 1965).

[2]Ibid., p. 52.

[3]Ibid., pp. 1-2.

[4]Ibid., p. 61.

[5]Ibid., p. 23.

[6]Ibid., pp. 23-8.

[7]Peter P. Ekeh, Social Exchange Theory: The Two Traditions (Cambridge, Mass.: Harvard University Press, 1974).

[8]Sir James G. Frazer, Folklore in the Old Testaments, Vol. 2 (London: Macmillan & Co., 1919).

[9]Bronislaw Malinowski, Argonauts of the Western Pacific (London: Routledge & Kegan Paul, 1922).

[10]Marcel Mauss, The Gift: Forms and Functions of Exchange in Primitive Societies (Glencoe, Ill.: Free Press, 1954).

[11]Claude Levi-Strauss, The Elementary Structure of Kinship (Boston: Beacon Press, 1969).

[12]George C. Homans, Social Behavior: Its Elementary Forms (New York: Harcourt, Brace & World, 1961); Peter M. Blau, Exchange and Power in Social Life (New York: John Wiley & Sons, 1964).

[13]Ekeh, Social Exchange Theory, p. 24.

[14]Ibid.

[15]Ibid., pp. 24-30; Jonathan H. Turner, The Structure of Sociological Theory (Homewood, Ill.: The Dorsey Press, 1974), p. 217.

[16]Robert K. Merton, Social Theory and Social Structure, enlarged ed. (New York: The Free Press, 1968), Part III on functional theory.

[17]Ekeh, Social Exchange Theory, pp. 30-3; Turner, Sociological Theory, p. 218.

[18]Ekeh, Social Exchange Theory, pp. 37-60.

[19]Derived from Ibid., pp. 49-56.

[20]Ibid.

[21]Ibid., pp. 84-165.

[22]Blau, Exchange and Power, p. 6.

[23]International Encyclopedia of the Social Sciences, Vol. 7. "Interaction: Social Exchange," by Peter M. Blau.

[24]Blau, Exchange and Power, pp. 253-265.

[25]Ibid., pp. 269-70.

[26]Ibid., pp. 93-95.

[27]Alvin W. Gouldner, "The Norms of Reciprocity," American Sociological Review 25 (April, 1960): 161-78.

[28]Merton, Social Theory, p. 100-1.

[29]Gouldner, "Reciprocity," p. 169.

[30]Talcott Parsons and Edward Shils, ed., Toward a General Theory of Action (Cambridge, Mass.: Harvard University Press, 1951; Harper Torchbook ec., 1962), p. 16.

[31]Gouldner, "Reciprocity," p. 169.

[32]Ibid., p. 176: Parsons and Shils, Theory of Action, pp. 14-16.

[33]Arthur L. Stinchcombe, Constructing Social Theories (New York: Harcourt, Brace & World, Inc., 1968), p. 100.

Chapter V

RESEARCH OUTPUT INDICATORS VIEWED FROM THE SOCIAL EXCHANGE PERSPECTIVE

A. Pertinent Indicators for Academic Engineering Departments

In a latter phase of the present study, a number of engineering departments at a university served as the context of an opinion survey. Therefore, the list of research output indicators suggested by the NCHEMS Outcome Measures Identification Study was modified so as to be applicable to these departments. The following changes were introduced:

Deletions: Faculty time devoted to research

Faculty involved in instructional technology

Graduates engaged in research

Invitations received to participate in professional conferences

Graduates with artistic creations

Additions: Research reports and bulletins

Dissertations

Invited papers

Research seminars

Invitations to judge research

Honorary elections

Department quality rating

An examination of the resultant list revealed that there were essentially two types of indicators: the first type was made up of surrogates of the knowledge outputs of the departments, and the second type consisted of the results of evaluations by external parties. These two kinds were designated, respectively, as knowledge-related and recognition-related indicators (Table 6).

The following discussion will cover three prominent aspects in social exchange theories: economic and social motives of exchange, the structure of reciprocity, and the valuation of research outputs.

B. Economic and Social Motives of Exchange

It may be recalled that one of the controversies in social exchange theories was the postulation of motives of actors in exchanges. Frazer and Blau emphasized the significance of economic or utilitarian motives, and this position was refuted by Malinowski, Mauss, and Levi-Strauss.[1] Since it is by no means clear that individual anthropological cases of primitive non-Western societies may be generalized to other settings, it is unnecessary in the present study to enter this controversy. Rather, in this study social exchanges are considered to include both noneconomic (symbolic) and economic (involving goods and services) exchanges. Under this definition, both symbolic and economic motives are admissible in social exchanges.

TABLE 6

RESEARCH OUTPUT INDICATORS FOR ACADEMIC ENGINEERING DEPARTMENTS

Knowledge-related Output Indicators	
K-1	Published articles
K-2	Research reports and bulletins
K-3	Dissertations
K-4	Invited papers
K-5	Research proposals
K-6	Patents and copyrights
K-7	Research and seminars
K-8	Commercial publications
Recognition-related Output Indicators	
R-1	Peer judgments of specific research projects
R-2	Citations
R-3	Invited papers
R-4	Invitations to judge research
R-5	Awards and prizes
R-6	Research proposals accepted for funding
R-7	Research funding
R-8	Honorary elections
R-9	Department quality rating

Hagstrom studied the exchange of information for recognition by scientists.[2] Since social recognition is valued for its symbolic significance, noneconomic motives may be postulated to underly this type of exchange. Unless material resources are involved, exchanges involving the recognition-related indicators may be regarded as motivated by nonutilitarian reasons. Research activities do, however, require material resources, as manifested by the indicators of research proposals funded and research funding. In the case of contracted research, it would seem unrealistic to presume only altruistic motives. The processes of submitting research proposals to prospective sponsors in the hope of receiving financial supports, and the granting of research contracts in the hope of receiving useful information, are based primarily on utilitarian rationality. These processes are well described by the double contingency model as generalized from the works of Frazer, Gouldner, and Blau. That is, unless there are mutual and commensurate returns to the investment by the research sponsor, the continuation of the relationship is jeopardized.

It will be shown in the next section that the exchange processes involving research output indicators are numerous and complex. They consist of economic and symbolic subprocesses, and are therefore quite different from the unitary processes considered by Frazer, Malinowski, and Levi-Strauss. This may be the reason why in the case under study, both economic and symbolic motives may be admissible without contradiction.

C. The Structure of Reciprocity

Frazer, Malinowski, and Homans dealt with direct exchanges involving two parties. While Blau did extend the interpersonal exchanges to those between macrostructures, Levi-Strauss, as amplified by Ekeh, was most explicit in formulating the structure of reciprocity. The formulation of Levi-Strauss and Ekeh could be seen as analytical abstractions which might not represent the full complexity of some exchange systems.[3] For example, research output indicators operate in a network of exchanges (Figure 3).

It may be observed that there are two basic processes in this network--diffusion and feedback. These correspond well to the chain and net in Levi-Strauss' model. Diffusion operates in a chain fashion in that one outcome probably leads to another, with the latter often being contingent upon the occurrence of the former. Thus one may trace the propagation of the indicators. For example, one possible path is research proposals → funding → research → journal articles → citations. This simple process may be combined with other processes. Feedback operates in conjunction with the diffusion process. Indeed, if there is no feedback, the viability of the whole system would be endangered. As a case in point, funding a research proposal is a positive

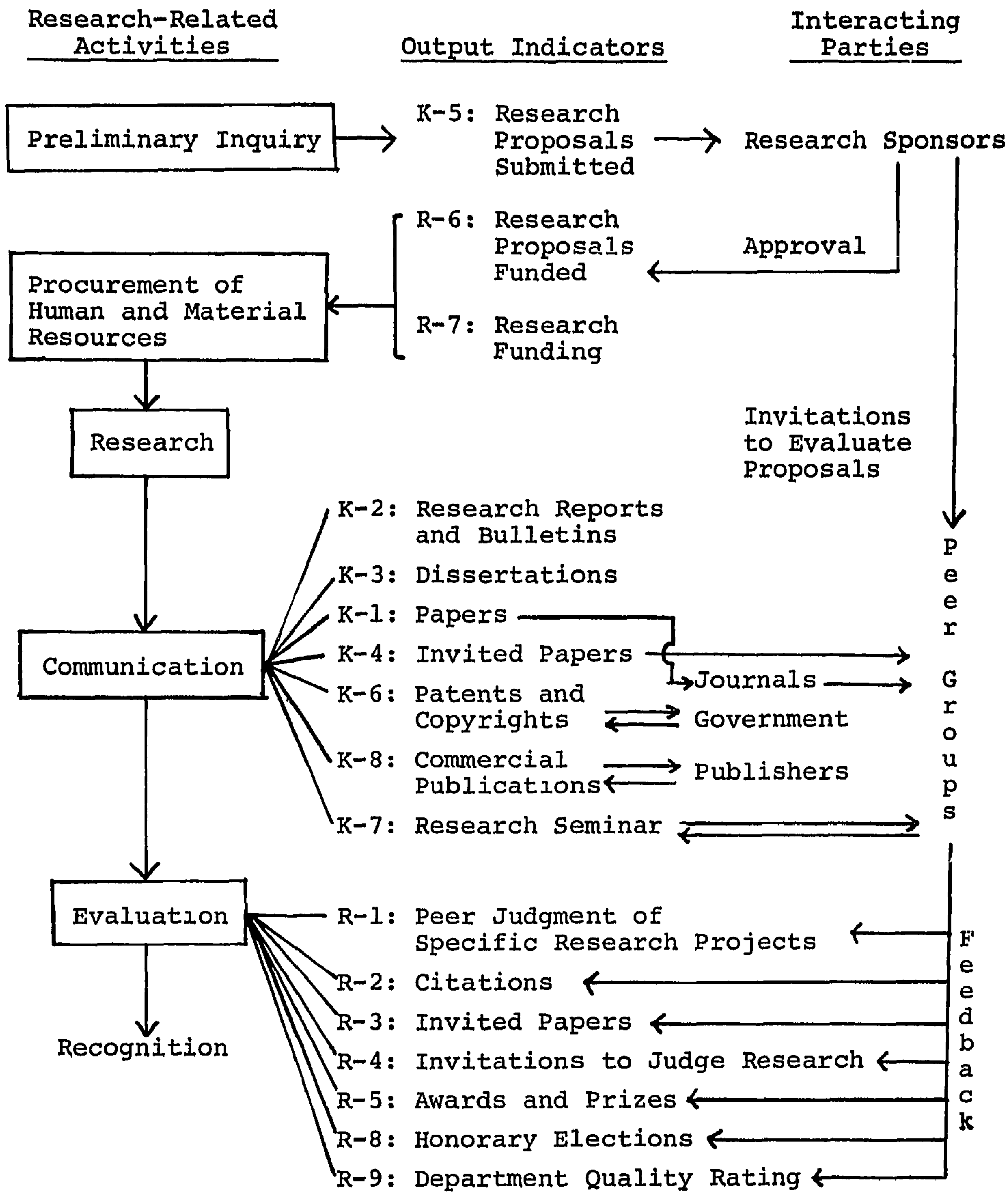

Figure 3. Research Output Indicators in Exchange Processes

feedback to the researcher who made the proposal. This feedback enables subsequent events to take place. Globally speaking, recognition is a feedback to the researcher in response to his perceived contribution to knowledge. Furthermore, recognition may be linked with resource generation, as will be explained later.

Diffusion and feedback are means by which members of the research community communicate and evaluate contributions to knowledge and related activities. Evaluation bridges diffusion and feedback, because what is fed back is often the result of evaluation. Thus evaluation occupies a central place in the production and dissemination of knowledge. Institutionalized evaluation, such as that by the referee system of journals, functions as a counterpart to the economic market pricing system. To the extent a journal is considered to be reputable, its acceptance of a manuscript is a measure of the quality of the manuscript. The results of peer evaluation of the substantive content of a piece of research also influence the distribution of organizational incentives.[4] Furthermore, one should also be aware of what Merton called the Mathew effect. That is, "the rich get richer at a rate that makes the poor become relatively poorer."[5] One implication of the Mathew effect is that "centers of demonstrated scientific excellence are allocated far larger resources for investigation than centers which have yet to make their mark."[6] This explains the feedback loop linking recognition indicators to resource inputs for research. This feedback is consistent with the output-to-input reconversion process in Katz and Kahn's open systems model, and with their concept of effectiveness. It is in this sense that research output indicators are elements in the input-output exchange system. (See the section "Research Output Indicators as Evaluative Criteria.")

D. The Valuation of Research Outputs

The previous discussion pointed out evaluation as a fundamental process in the network of exchanges research output indicators. An evaluation is an assessment of the worth of an object, and is broader than valuation, which attaches a measurable value to an object. It will be recalled that the major contributors to social exchange theories were divided on the issue valuation of exchange items. Malinowski denied that social (as versus economic) exchange items had economic values. Frazer, Homans, and Blau, on the other hand, invoked the economic principle of supply and demand in the determination of the value of scarce resources. Finally, Levi-Strauss pointed out the distinction between physical scarcity, which led to economic value, and social scarcity, which was induced by social norms.[8] Beyond this, social exchange theories could offer little guidance in the valuation of exchange items.

As soon as one admits the possibility of the existence of social value, one is confronted with the problems of measuring it. The universal acceptance of money makes it an ideal medium of exchange. Do there exist comparable standards which may serve as bases for the valuation of noneconomic exchange items? Blau saw universalistic values as a potential extension of money as media of exchange and valuation.[9] Therefore, in noneconomic exchanges in which the exchange items may not be amenable to valuation, evaluations using universalistic values would still be possible and indeed necessary.

One type of universalistic value is what Merton called "the ethos of science."[10] These were universalism, communism, disinterestedness, and organized skepticism. Universalism meant that claims to knowledge should be subject to "pre-established impersonal criteria: consonant with observation and with previously confirmed knowledge." Communism in this context meant that scientific knowledge belonged to the public domain; the society ideally should reward its discoverer with recognition and esteem commensurate with the significance of the knowledge. Disinterestedness entailed the findings of one scientist be verified by fellow scientists to establish its validity. Finally, organized skepticism required "the temporary suspension of judgment and the detached scrutiny of belief in terms of empirical and logical criteria."[11]

These ethos of science serve as what Blau called "value consensus."[12] It is only when there is an acceptable level of value consensus that the work of some researchers can be evaluated by others. This kind of evaluation is institutionalized into the referee system of journals. Referees and editors perform the role of status judges. These judges, in the words of Merton and Zuckerman, "are integral to any system of social control through the evaluation of role performance and their allocation of rewards for that performance. They influence the motivation to maintain or to raise standards of performance."[13] Furthermore, the referee system provides "an institutional basis for the comparative reliability and cumulation of knowledge."[14] Editors and referees as a group allocate scarce space in scholarly journals to the contributors, presumably on the basis of merits of the manuscript submitted. To the extent that journals are an effective means of disseminating new knowledge to one's peers--a necessary step for further peer recognition--published articles in reputable journals are also an indicator of recognition of their merits.

E. Concluding Remarks

Research output indicators are the consequences of conducting research. There are two orders to these consequences: first-order consequences are called knowledge-related indicators and second-order consequences are recognition-related indicators. Knowledge-related indicators could be considered as media of communication in the research community, whose importance was underscored by the Committee on Scientific and Technical Communication of the National Academy of Sciences and the National Academy of Engineering: "A fundamental article of faith in scientific and technical communication is that research is not complete until results are made available."[15] Research results made public are subject to the evaluation of peer groups and possibly other interested parties, such as beneficiary groups. These groups would then bestow social recognition upon the researcher whose contribution to knowledge is considered to be significant, giving rise to the recognition-related indicators.

In attempting to find a theoretical model to explain the consequences of research, one might be tempted to use a functional analysis which would explain well the direct consequences of research, as represented by the knowledge indicators. However, if it failed to consider the feedback of the recipients of knowledge to the researcher, it would not be able to account for the recognition indicators. This was a primary reason for preferring the exchange model as a theoretical framework. Stinchcombe showed that it was possible to incorporate reverse causal processes into a functional explanation.[16] This would add the feedback processes previously neglected in functional analysis. In this study the functional analysis is considered to be a component of the more encompassing exchange perspective.

Footnotes for Chapter V

[1]See Chapter IV, Section C.

[2]See Chapter IV, Section B.

[3]See Chapter IV, Section C.

[4]Hagstrom, Scientific Community, pp. 37-39.

[5]Robert K. Merton, The Sociology of Science: Theoretical and Empirical Investigations, ed. Norman W. Storer: "The Mathew Effect in Science" (Chicago: University of Chicago Press, 1973), p. 457.

[6]Ibid.

[7]See Chapter IV, Section A.

[8]See Chapter IV, Section C.

[9]Blau, Exchange and Power, pp. 253-265.

[10]Merton, Sociology of Science: "The Normative Structure of Science," pp. 267-78.

[11]Ibid., pp. 270-77.

[12]Blau, Exchange and Power, p. 24.

[13]Robert K. Merton and Harriet Zuckerman, "Institutionalized Patterns of Evaluation in Science," in Merton, Sociology of Science, p. 495.

[14]Ibid.

[15]National Academy of Sciences-National Academy of Engineering, Committee on Scientific and Technical Communication, Scientific and Technical Communication: A Pressing National Problem and Recommendation for Its Solution (Washington, D.C.: National Academy of Sciences, 1969), p. 86.

[16]Stinchcombe, Social Theories, pp. 80-101.

Chapter VI

MEASURING ORGANIZATIONAL CONSENSUS REGARDING THE RELATIVE IMPORTANCE OF RESEARCH OUTPUT INDICATORS

A. Research Output Indicators as Evaluative Criteria

It is proposed that research output indicators may be used as criteria for evaluating the effectiveness of academic organizations in conducting research. From the analysis in the previous chapter, it is quite evident that academic organizations are open systems, in the sense that they engage in exchanges with their environments. It is in terms of these environmental transactions that Katz and Kahn defined the concept of effectiveness. To them, organizational effectiveness is the extent to which energic return to the organization is maximized.[1] Energic return is a generic term for human and nonhuman resources, and is generated by the reconversion of the outputs of the organization. In most generic terms, their open systems model may be shown as follows:

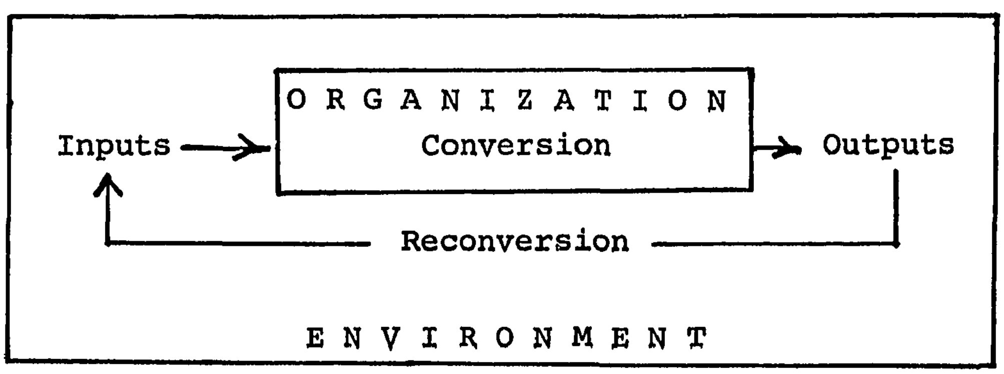

Figure 4. Katz and Kahn's Open Systems Model[2]

Katz and Kahn's concept of organizational effectiveness is consistent with Thompson and McEwen's emphasis of organization goals as an interaction between the organization and its environment and the procurement of environmental support.[3] In the case of academic organizations, knowledge outputs are produced and disseminated to the environment where they are evaluated and help to attract resources to the organizations in a way remarkedly similar to the Katz and Kahn model (Figure 5).

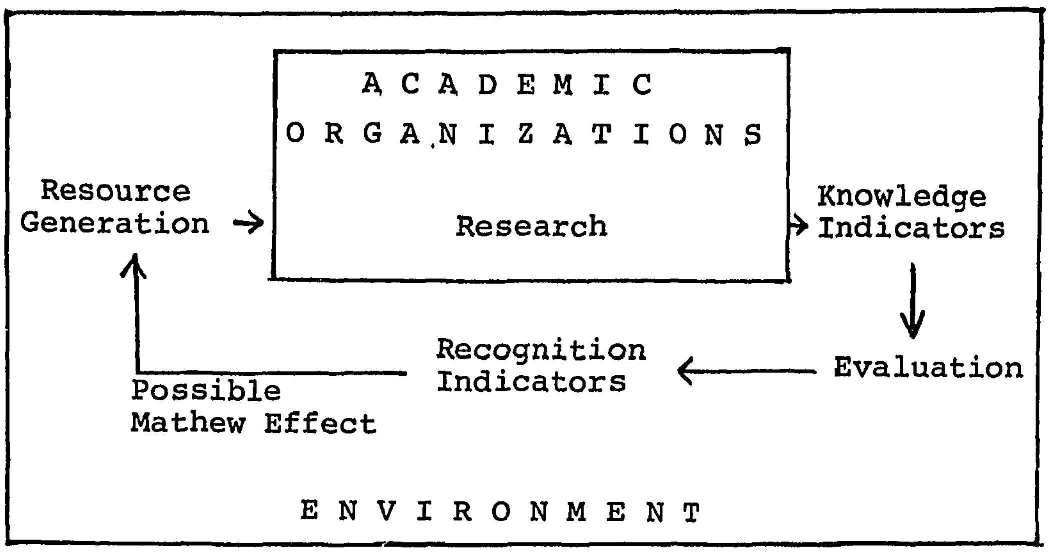

Figure 5. The Flow of Research Output Indicators

Thompson made an instructive distinction between intrinsic and extrinsic criteria of evaluation.[4] Though Thompson did not seem to define them explicitly, from the context one may infer that intrinsic criteria refer to qualitative standards and extrinsic criteria refer to standards that do not necessarily capture the qualitative dimension. For example, Thompson asserted that when universities found it difficult to evaluate the quality of faculty research, they turned to such measures as the number of publications, research grants received, or job offers.[5] Research output indicators are surrogates of the substantive knowledge outputs and are manifestations of social recognition of research achievement; as such they are extrinsic criteria of evaluation.

Extrinsic criteria tend to be used when organizations find it difficult to evaluate performance by intrinsic criteria, when the knowledge of causal relationships is believed to be incomplete, or when pertinent interactors in the environment do not possess the technical competency to evaluate performance.[6] Evaluations of research by fellow researchers are likely to be based on intrinsic criteria. However, administrative evaluations, especially at levels rather removed from the researcher, are apt to resort to extrinsic criteria.

There are dangers in using extrinsic criteria in evaluation. Etzioni cautioned against overmeasuring the measurables which might not be the substantive output of the organization, thereby distorting the organization's goals.[7] Warner and Havens also warned the dangers of inverting means and ends when organizational goals were intangible.[8] Admittedly, quality of research is more essential than the quantity of research. Previously it was suggested that intrinsic evaluation had often taken place before some output indicators would come into being and be measured. To this extent, some output indicators are endowed with some, though limited, intrinsic significance.

Organizational evaluation of performance tends to use organizational goals as reference points. Current thinking in accounting views accounting information as an instrument for the assessment of goal achievement. (See Chapter II) The reliance on the goals as a source of evaluative criteria is so heavy that it is advisable to examine closely the concepts and theories of organizational goals. This is done in the following section.

B. Accounting Implications of the Goal Paradigm

There are various definitions of organization goals; however, from them one may discern some common grounds. Etzioni and Thompson clearly recognized goals as oriented to the future.[9] Many writers also concurred that policy and resource commitments were necessary conditions for intentions to be recognized as goals.[10] The study of output indicators is consistent with this tradition in search of the "real" goals of organizations--real in the sense of being confirmed by actual behavior directed at goal achievement. Assuming rationality, outputs are produced in furtherance of goal accomplishment. As Etzioni put it, "[o]utput is usually related to, but not identical with organizational goals."[11] For instance, academic organizations have the goal of carrying on pure and applied research; and they produce knowledge, which is surrogated by knowledge indicators. By means of exchange analysis, the reconversion of knowledge indicators into input resources is explained and made compatible with the concept of effectiveness advanced by Katz and Kahn.

In recent years, a number of writers resurrected a fundamental issue: In what sense may organizations be considered to have goals?[12] To attribute goals to organizations, argued Silverman, entailed the problem of reification--"the attribution of concrete reality, particularly the power of thought and action, to social constructs."[13] Greenfield echoed Bavelas in regarding organizations as "social inventions."[14] Georgiou invoked Barnard's dictum that "the individual is always the basic strategic factor in organization,"[15] as a starting point toward a counter-paradigm to the goal paradigm. Following Barnard, Georgiou viewed organizations as "a market place in which incentives are exchanged" between the organization and its participants.[16]

This seemingly contemporary awareness of the reification problem had been recognized quite some time ago. Simon considered defining organization goals in terms of those of organizational members because this would have the advantage of avoiding "the danger of reifying the organization."[17] Of course, as noted earlier, Bavelas in 1960 regarded organizations as social inventions. Even earlier Parsons and associates recognized that "The concept of motivation in a strict sense applies only to individual actors. The motivational components of the action of collectivities are organized systems of motivation of the relevant individual actors."[18]

An accounting implication of the recognition of the reification problem is the need to reexamine the concept of the accounting entity. Traditionally, the accounting entity is held to be an impersonal going concern having an existence independent of its incumbent participants.[19] This perception of an organization tends to dull the accountant's sensitivity to values of organizational members and their possible differences. To the extent that "organizational goals are a series of independent aspiration-level constraints imposed on the organization by members of the organizational coalition,"[20] the accountant needs to be keenly aware that performance measures derived from organization goals are fundamentally subjective. Furthermore, Cyert and March observed that "most organizations most of the time exist and thrive with considerable latent conflict of goals."[21] This gives rise to the need to investigate the extent of organizational consensus regarding the criteria of evaluation. The next and last section describes a survey conducted to investigate this issue.

C. The Design of an Opinion Survey

An Overview

The objective of this survey was to ascertain the extent of organizational consensus regarding the relative importance of research output indicators analyzed earlier in this study. The survey was focused on three engineering departments at a large, research-intensive university. Participants in the survey were asked to rank order two series of research output indicators. The criterion for ranking the knowledge indicators was their importance in judging the effectiveness of the departments in conducting research. The criterion for ranking the recognition indicators was their importance in judging the recognition of excellence of these departments in research. In both cases, the participants were requested to express their normative preferences, that is, what the case should be. The ranks assigned to each indicator by various groups were then analyzed by the nonparametric Kruskal-Wallis one-way analysis of variance (ANOVA) for possible differences in group means.[22] In case significant differences were found, Dunn's multiple comparisons[23] were performed to ascertain which groups differed. Parametric ANOVA were also made to ascertain the impact of violating the large sample assumption due to using the chi-square approximation.

A Profile of the Survey Participants

The following table shows the composition of the various groups of participants in the survey:

TABLE 7

THE COMPOSITION OF SAMPLES IN THE OPINION SURVEY

Group	FAC	ADM	Total
CE	12	3	15
EE	9	2	11
MIE	7	3	10
COLL		2	2
CAMP		2	2
UNIV		2	2
Total	28	14	42

The selection of administrators for this survey was based on their positions. At each level of the administrative hierarchy, key academic officers having research-related responsibilities were invited to participate. The faculty participants from each department were selected by means of a random number table. In the case of Civil and Electrical Engineering Departments, the samples constituted about 20% of the respective faculty. The inclusion rate for the

Mechanical and Industrial Engineering Department was about 15%. The overall inclusion rate was 18%.

The Questionnaire and the Survey Procedure

Two forms of the same questionnaire were used. Form A was used for faculty and departmental administrators, who were asked to express their preferences with respect to their own departments. Form B was used for administrators at the college, campus, and university levels. These respondents were to express their preferences with respect to an engineering department in the institution. In this way, the groups would have the same frame of reference. Sample questionnaires are included in Appendix A.

It may be recalled that in the Gross and Gramsch study, both perceptions and preferences of the respondents were solicited. A question asking for perceptions of what is actually the case requires factual knowledge. Since this condition was not believed to be satisfied for all respondents in the present survey, only the participants' normative preferences were sought. This distinction was emphasized in the instructions in the questionnaires, as were the criteria for comparing the indicators.

To ensure a high response rate and the completion of the questionnaire by the designated person, the questionnaire was administered during a prearranged face-to face interview session in most cases. When this procedure was infeasible, the respondent was asked to complete the questionnaire and return it by mail to the author. The entire survey was conducted during the month of April 1975.

Statistical Hypotheses and Testing

Organizational consensus was operationalized as the absence of significant differences in the means of ranks assigned by the various organizational groups. The data obtained from the survey were ordinal. Since there were more than two groups to be compared at the same time, the Kruskal-Wallis one-way analysis of variance (ANOVA) by rank was used to detect possible differences. If the null hypothesis of no difference was rejected at a significance level of 0.10, Dunn's multiple comparisons were performed to ascertain the sources of differences.

Kruskal-Wallis Analysis of Variance

a. Data

Each respondent was asked to rank order the two series of indicators. Thus for each indicator, there were 42 assigned ranks, X_{ij}, where X_{ij} = the rank assigned by the ith individual in the jth group. The data array for the analysis of variance on each indicator is presented in Table 8.

TABLE 8

DATA ARRAY FOR AN ANALYSIS OF VARIANCE
ON EACH INDICATOR

	Groups Compared			
Participant	1	2	. . .	k
1	X_{11}	X_{12}	. . .	X_{1k}
2	X_{21}	X_{22}	. . .	X_{2k}
.	.	.		.
.	.	.		.
.	.	$X_{n_2 2}$		.
.	.			.
	.			.
	$X_{n_1 1}$			.
				.
				$X_{n_k k}$
Group Size	n_1	n_2	. . .	n_k

b. Statistical Model and Assumptions[24]

The basic model used by the Kruskal-Wallis analysis is

$$X_{ij} = \mu + \tau_j + \varepsilon_{ij}\ ; \quad i = 1, 2, \ldots, n_j\ ; \quad j = 1, 2, \ldots, k$$

where: μ = the unknown overall mean

τ_j = the unknown jth group effect,

$$\sum_{j=1}^{k} \tau_j = 0.$$

It is further assumed that the error terms (ε's) are mutually independent and each comes from the same continuous population.

c. Hypotheses

(1) Comparing the faculty of three departments. The null hypothesis was:

$$\tau_{CE.FAC} = \tau_{EE.FAC} = \tau_{MIE.FAC}$$

against the alternative hypothesis that not all the τ's were equal.

(2) Comparing the faculty of a department with the administrators of the same department, and with administrators at the college, campus, and university levels. The null hypotheses were:

$$\tau_{CE.FAC} = \tau_{CE.ADM} = \tau_{COLL.ADM} = \tau_{CAMP.ADM} = \tau_{UNIV.ADM}$$

$$\tau_{EE.FAC} = \tau_{EE.ADM} = \tau_{COLL.ADM} = \tau_{CAMP.ADM} = \tau_{UNIV.ADM}$$

$$\tau_{MIE.FAC} = \tau_{MIE.ADM} = \tau_{COLL.ADM} = \tau_{CAMP.ADM} = \tau_{UNIV.ADM}$$

against the alternative hypotheses that not all the τ's were equal.

d. Computational Procedure[25]

(1) Arrange all the N responses in ascending order, where N is equal to the total number of responses in a given analysis. Let r_{ij} denote the rank of X_{ij} in this joint ordering. Where ties occur, the average ranks are used.

(2) Let, for $j = 1, 2, \ldots, k$,

$$R_j = \sum_{i=1}^{n_j} r_{ij} \; ; \quad R_{.j} = R_j/n_j \; ; \quad R_{..} = (N + 1)/2$$

(3) Compute

$$H = \frac{12}{N(N + 1)} \sum_{j=1}^{k} n_j (R_{.j} - R_{..})^2$$

$$H = \left[\frac{12}{N(N + 1)} \sum_{j=1}^{k} \frac{R_j^2}{n_j} \right] - 3\,(N + 1).$$

(4) In case of ties,

$$H' = \frac{H}{1 - \dfrac{\sum_{j=1}^{g} T_j}{N^3 - N}}$$

where:

g = number of tied groups,

$T_j = t_j^3 - t_j$;

t_j = the size of the jth tied group.

e. Decision[26]

Since at least one group had $j_n > 5$, and since in the second series of comparisons, the number of groups being compared exceeded three, the large sample approximation was used. Under the null hypothesis, H or H' had an asymptotic Chi-square (χ^2) distribution based on k-1 degrees of freedom. The decision rules were:

Reject the null hypothesis if $H' \geq \chi^2_{(k-1,\ \alpha)}$

Do not reject the null hypothesis if $H' < \chi^2_{(k-1,\ \alpha)}$

at the significance level of 0.10.

Dunn's Multiple Comparisons

In case the null hypothesis was rejected by the Kruskal-Wallis test, Dunn's multiple comparisons based on rank sums were then performed to identify the sources of differences. The Dunn method is applicable to the present study in which each group did not have the same number of participants. In order to obtain maximum information, pairwise comparisons were made. For the faculty-faculty comparisons, there were $\binom{3}{2}$ or 3 contrasts to be evaluated. For the faculty-administrator comparisons, there were $\binom{5}{2}$ or 10 contrasts to be evaluated. For each contrast, the following procedure was followed:[27]

a. Computational Procedure

1. Calculate the value of the contrast (y).

   $y = R_{.j} - R_{.j'}\ ,\ j \neq j'$

2. Find the value of the standard deviation of y.

$$\sigma = \left[\frac{N(N+1)}{12} - \frac{\sum_{j=1}^{g} T_j}{12(N-1)} \right]^{\frac{1}{2}} \cdot \left[\frac{1}{n_j} + \frac{1}{n_{j'}} \right]^{\frac{1}{2}}$$

3. Compute y/σ.

b. Decision

If $y/\sigma < - z_{\alpha/k(k-1)}$, then $\tau_j < \tau_{j'}$, with the probability $1-\alpha$.

If $y/\sigma > z_{\alpha/k(k-1)}$, then $\tau_j > \tau_{j'}$, with the probability $1-\alpha$.

If $- z_{\alpha/k(k-1)} \leqq y/\sigma \leqq z_{\alpha/k(k-1)}$, then τ_j and $\tau_{j'}$ may be equal.

D. Analysis of Data

A series of analyses were made regarding group mean differences and the relative importance of the indicators. The results of the Kruskal-Wallis ANOVA used to detect significant group mean differences are summarized in Table 9. In cases where one or possibly more group mean differences were found to be significant at the 0.10 level, Dunn's multiple comparisons procedure, which is appropriate for unequal sample sizes, was used to identify the sources of such differences. However, since the large-sample assumption of the Dunn procedure was violated by the data, the procedure failed to identify the sources of significant differences in some cases. It may be assumed, nevertheless, that the pair of groups having the highest absolute value of y/σ would be the likely candidate for the source. The results of this analysis

TABLE 9

SUMMARY OF RESULTS OF THE KRUSKAL-WALLIS TEST

	Comparison			
Indicator	I	II	III	IV
K-1		**	*	**
K-2	*	***	*	***
K-3	*	**	*	*
K-4	*		*	*
K-5		*	*	**
K-6	*	**	*	**
K-7		**	*	*
K-8	*		*	*
R-1	*	*	*	
R-2			*	
R-3		*		*
R-4	*	**	*	**
R-5		*	*	***
R-6		*	*	*
R-7		*	*	*
R-8	**	*	*	*
R-9	*	*	*	

(1)

Comparison	Groups Compared
I	CE.FAC, EE.FAC, MIE.FAC
II	CE.FAC, CE.ADM, COLL.ADM, CAMP.ADM, UNIV.ADM
III	EE.FAC, EE.ADM, COLL.ADM, CAMP.ADM, UNIV.ADM
IV	MIE.FAC, MIE.ADM, COLL.ADM, CAMP.ADM, UNIV.ADM

(2) P = the probability of occurrence of the obtained test statistic H under the null hypothesis of no group difference with respect to the mean with the appropriate degrees of freedom.

Symbol	Value of P
***	$P \leq 0.05$
**	$0.05 < P \leq 0.10$
*	$0.10 < P \leq 0.50$
[Blank]	$0.50 < P$

(3) For the parametric counterpart of these comparisons, refer to Appendix C.

are presented in Table 10. The details of both the Kruskal-Wallis and Dunn analyses are available in Appendix B.

To ascertain the relative importance of the indicators, two mean importance scores were computed for each of the indicators--one score for faculty and another for administrators--by assuming equality of the intervals between ranks. A mean importance score is defined as the sum of ranks assigned by members of a group divided by the number of individuals in that group. Table 11 shows the rankings by faculty and administrators for the two series of indicators by descending importance, that is, by ascending mean importance scores.

The following discussion attempts to discern some patterns existing in the empirical data and sharpened by the analyses.

(1) Articles published in prestigious journals (K-1) were almost universally recognized as the most important knowledge indicator in judging the research effectiveness of an engineering department, as evidenced by the following distribution of the assigned ranks:

Assigned Ranks	Faculty	Administrator
1 and 2	93%	93%
3 to 6	7	7
Total	100%	100%

Since an overwhelming majority of the survey participants assigned a rank of 1 to this indicator, the ranks of 2 and 4 given by the UNIV.ADM became significantly different

TABLE 10

PAIRS OF GROUPS HAVING THE HIGHEST ABSOLUTE VALUES OF y/σ

	Indicator	y/σ	Comparison	Groups
K-1	Published Articles	-2.50	II	CE.ADM vs UNIV.ADM
		-2.58*	IV	MIE.ADM vs UNIV.ADM
K-2	Research Reports and Bulletins	-2.60*	II	CE.ADM vs COLL.ADM
		-2.56*	IV	MIE.FAC vs COLL.ADM
K-3	Dissertations	-2.27	II	CE.FAC vs UNIV.ADM
K-5	Research Proposals	+2.44	IV	MIE.FAC vs UNIV.ADM
K-6	Patents and Copyrights	+2.49	II	COLL.ADM vs UNIV.ADM
		+2.30	IV	COLL.ADM vs UNIV.ADM
K-7	Research Seminar	-2.70*	II	COLL.ADM vs UNIV.ADM
R-4	Invitation to Judge Research	+2.34	II	CAMP.ADM vs UNIV.ADM
		+2.36	IV	CAMP.ADM vs UNIV.ADM
R-5	Awards and Prizes	-2.70*	IV	MIE.ADM vs UNIV.ADM
R-8	Honorary Elections	-2.07	I	CE.FAC vs MIE.FAC

(1) * Denotes that Dunn's procedure did indicate a significant difference in that case.

(2) For the description of groups involved in each comparison, refer to note (1) of Table 9.

TABLE 11

RANKING OF INDICATORS BY DESCENDING IMPORTANCE

Rank	MIS*	Faculty	Rank	MIS*	Administrator
		Knowledge-related Indicators			
1	1.50	K-1 Published articles	1	1.36	K-1 Published articles
2	3.11	K-3 Dissertations	2	2.36	K-4 Invited papers
3	3.68	K-4 Invited papers	3	3.79	K-3 Dissertations
4	4.32	K-2 Research reports and bulletins	4	4.57	K-5 Research proposals
5	4.89	K-8 Commercial publications	5	5.29	K-2 Research reports and bulletins
6	5.96	K-5 Research proposals	6	6.00	K-6 Patents and copyrights
7	6.00	K-7 Research seminars	7	6.07	K-8 Commercial publications
8	6.50	K-6 Patents and copyrights	8	6.29	K-7 Research seminars
		Recognition-related Indicators			
1	2.32	R-1 Peer judgments of specific research projects	1	2.29	R-1 Peer judgments of specific research projects
2	4.57	R-5 Awards and prizes	2	4.00	R-9 Department quality rating
3	4.89	R-9 Department quality rating	3	4.14	R-5 Awards and prizes
4	5.07	R-7 Research funding	4	4.64	R-6 Research proposals accepted for funding
5	5.14	R-2 Citations	5	4.93	R-3 Invited papers
6	5.18	R-3 Invited papers	6	6.07	R-2 Citations
6	5.18	R-6 Research proposals accepted for funding	6	6.07	R-8 Honorary elections
8	6.04	R-8 Honorary elections	8	6.29	R-7 Research funding
9	6.43	R-4 Invitations to judge research	9	6.57	R-4 Invitations to judge research

* MIS--Mean Importance Scores--were computed by assuming equal intervals between adjacent ranks, which may not hold for ordinal data.

from the ranks attributed by CE.ADM and MIE.ADM. In fact, the UNIV.ADM were involved in so many of the significant differences that this situation deserved some further attention.

(2) Looking at the pairs of groups having the highest absolute values of y/σ, that is, those groups whose mean preferences differed the most (Table 10), one may observe a remarkable pattern based on the signs of y/σ. The sign of y/σ indicates the direction of the difference: a negative sign means that the first group attributed greater importance to the indicator than did the second group, and a positive sign means the opposite. Thus the signs suggest that UNIV.ADM considered published articles (K-1), dissertations (K-3) and research seminars (K-7) as <u>less</u> important than did the respective corresponding groups. By the same token, UNIV.ADM regarded research proposals (K-5) and patents and copyrights (K-6) as <u>more</u> important than did the respective corresponding groups. An examination of the groups involved in the greatest disagreements (Table 10) revealed that there were at least as many disagreements among the administrator groups as between faculty and administrators.

(3) For the reason mentioned immediately above, a further analysis was made regarding the variations in preferences among the administrator groups, particularly in the cases of research proposals (K-5) and patents and copyrights (K-6). The empirical data presented in Table 12 cast doubt

on the null hypothesis that all of the groups had similar means regarding the relative importance of research proposals. It is also noteworthy that CAMP.ADM and UNIV.ADM attributed greater importance to patents and copyrights than did other groups.

TABLE 12

MEAN IMPORTANCE SCORES OF RESEARCH PROPOSALS AND OF PATENTS AND COPYRIGHTS

		Mean Importance Scores*	
Group	Number	Research Proposals	Patents and Copyrights
FAC	28	5.96	6.50
DEPT.ADM	8	4.75	6.88
COLL.ADM	2	5.50	8.00
CAMP.ADM	2	4.50	4.50
UNIV.ADM	2	3.00	2.00

* Mean importance scores were computed in the same manners as those for Table 11.

These empirical results may be explained by the different types of exchanges in which faculty and administrators participate. Although faculty-researchers deal with research sponsors and would be concerned with research funding, their primary exchange is with fellow researchers concerning substantive research. Administrators, on the other hand, play supportive roles in the university, and would therefore be expected to regard research proposals more highly as resource generating instruments than would faculty-researchers. However, the data suggests that there is considerable and patterned heterogeneity within the administrative hierarchy. It may be observed that as the organizational distance from faculty-researchers increases, there is a steady rise in the importance of research proposals. Another way of interpreting the data is that administrators' faculty-oriented preference increases as the administrators are organizationally closer to the researchers. This is congruent with the phenomenon that academic administrators are often former faculty members and would therefore retain faculty-oriented preferences to a variable extent depending on their organizational distance from practicing researchers.

With regard to patents and copyrights, an explanation for the evidence is that patents were an issue of concern to a number of key administrators at the campus and university levels at the time the survey was taken. It is possible that these individuals therefore regarded patents as important for engineering departments some of whose research results could be patented. This is another illustration of how some administrators viewed the institutional significance of the results of academic research.

(4) In the literature review earlier, it was observed that Gross and Gramsch concluded in their study of university goals that the normative goal structures of faculty members and administrators were not significantly different, nor were those of administrators at various levels of the administrative

hierarchy. Tables 9 and 10 and the earlier discussion specify the sources and nature of the significant and noticeable differences. An overall picture is provided by Table 11, which ranks the indicators by descending importance as defined separately for faculty and administrators. If one allows for the imperfections of the measurement scale and regards adjacent ranks as indistinguishable, an inference from the data would be that faculty and administrators agreed in a majority of the cases.

Footnotes for Chapter VI

[1]Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations (New York: John Wiley & Sons, 1966), pp. 149-170.

[2]Based on Ibid.

[3]James D. Thompson and William J. McEwen, "Organizational Goals and Environment: Goal Setting as an Interaction Process," American Sociological Review 23 (February, 1958): 28-9.

[4]James D. Thompson, Organizations in Action (New York: McGraw-Hill, 1967), pp. 90-3.

[5]Ibid., p. 91.

[6]Ibid., pp. 91-2.

[7]Amitai Etzioni, Modern Organizations (Englewood Cliffs, N.J.: Prentice-Hall, 1964), pp. 8-12.

[8]W. Keith Warren and A. Eugene Havens, "Goal Displacement and the Intangibility of Organizational Goals," Administrative Science Quarterly 12 (March, 1968): 539-55.

[9]Etzioni, Organizations, p. 6; Thompson, Organizations, p. 127.

[10]Charles Perrow, "The Analysis of Goal in Complex Organizations," American Sociological Review 26 (December, 1961): 854-866; Etzioni, Organizations, p. 7; Bertram Gross, Organizations and Their Managing (New York: Free Press, 1968), pp. 265-6; Vernon E. Buck, "A Model for Viewing an Organization as a System of Constraints," in Approaches to Organization Design, ed. James D. Thompson (Pittsburgh: University of Pittsburgh Press, 1966), pp. 103-172.

[11]Etzioni, Organizations, p. 8.

[12]D. Silverman, The Theory of Organizations (London: Heinemann, 1970);

T. B. Greenfield, "Organizations as Social Inventions: Rethinking Assumptions about Change," Journal of Applied Behavioral Science 9 (September and October, 1973): 551-574;

Petro Georgiou, "The Goal Paradigm and Notes Toward a Counter Paradigm," Administrative Science Quarterly 18 (September, 1973): 291-310.

[13]Silverman, Organizations, p. 9.

[14]A. Bavelas, "Leadership: Man and Function," Administrative Science Quarterly 4 (March, 1960): 498.

Greenfield, "Organizations as Social Inventions."

[15]Chester I. Barnard, The Functions of the Executive (Cambridge, Mass.: Harvard University Press, 1938), p. 139.

[16]Georgiou, "Goal Paradigm and Counter Paradigm," p. 306.

[17]Herbert A. Simon, "On the Concept of Organizational Goal," Administrative Science Quarterly 9 (June, 1964): 2.

[18]Parsons and Shils, Theory of Action, p. 4.

[19]Paul Grady, Inventory of Generally Accepted Accounting Principles for Business Enterprises (New York: AICPA, 1965), pp. 26-30.

[20]Richard Cyert and James G. March, A Behavioral Theory of the Firm (Englewood Cliffs, N.J.: Prentice-Hall, 1963), p. 117.

[21]Ibid.

[22]Myles Hollander and Douglas A. Wolfe, Nonparametric Statistical Methods (New York: John Wiley & Sons, 1973), pp. 115-116.

[23]Olive Jean Dunn, "Multiple Comparisons Using Rank Sums," Technometrics 6 (August, 1964): 241-52.

[24]Hollander and Wolfe, Nonparametric Statistical Methods, p. 115.

[25]Ibid, pp. 115-116.

[26]Ibid, p. 115.

[27]Dunn, "Multiple Comparisons," pp. 241-2.

Chapter VII

SUMMARY

A. Summary of Major Results

This study was motivated in part by an objective of accounting to assist the evaluation of performance of not-for-profit organizations. A university is a not-for-profit institution, one of whose functions is to carry on research and produce knowledge. Since knowledge itself is a complex concept almost defying measurement, surrogates for it were found in a recent Higher Education Outcome Measures Identification Study (OMIS) by the National Center for Higher Education Management Systems (NCHEMS). After surveying college and university administrators and state-level decision makers concerned with higher education, a subsequent phase of the study reached the conclusion that only two financial indicators--research proposals funded and research funding--were deemed sufficiently important to merit data acquisition. These measures are usually considered to be inputs unless otherwise rationalized. Therefore no nonfinancial output indicators were considered to be of sufficient interest to the respondents of the NCHEMS study.

The present study took the research output indicators proposed by the OMIS and adapted them to be relevant for academic engineering departments. There were essentially two parts of this study: a theoretical part that attempted to conceptualize research output indicators from an exchange perspective, and an empirical part that attempted to ascertain the extent of organizational consensus regarding the relative importance of research output indicators as criteria of evaluation of research effectiveness and recognition. Both of these phases of the study were designed to overcome some of the observed weaknesses and limitations of the NCHEMS study.

Research is undoubtedly an intellectual activity; in addition there are economic and social demensions to it. Organized research in the university helps to attract resource support and social recognition to the institution, by producing knowledge and disseminating it to interested parties. Thus it seems logical to consider the output indicators of research in terms of an exchange framework. Hagstrom's information-recognition exchange model is a precedent of this view; however, it failed to account for many of the indicators proposed. A more complex model was needed, and the literature of social exchange was searched for useful concepts and theories. It was found that while the subject matters dealt with in extant social exchange theories were of little relevance to the present study, the theories were useful in delineating three key issues: (1) the economic and social motives of exchange; (2) the structure of reciprocity; and (3) the valuation of exchange items.

It was found instructive to classify research output indicators into two groups--knowledge-related and recognition-related. Knowledge-related indicators embody the intellectual products of research, while recognition-related indicators are evidence of the research community as a social system. The system allocates resources and honors to researchers who have demonstrated their potentials or achievements, thereby providing economic and social incentives for research. The structure of reciprocity is not like the distinct types as specified in even the most complex social exchange structure, but exists in a network of connected processes of diffusion and feedback. The diffusion process disseminates knowledge as embodied in its surrogates to interested parties, who then evaluate it and provide feedback to the researcher via various channels. The evaluation of contributions to knowledge by peers acts as the counterpart of the valuation of economic goods and services in the market pricing system.

The last part of the study addressed the question of research output indicators as criteria of organizational evaluation. It has been argued that organizational evaluation should be in terms of organizational goals. This position presumes the existence of organizational goals and has been disputed by a number of organizational theorists who viewed organizational goals as fundamentally those of members of the organization concerned. Derivatively, criteria of organizational evaluation would also be subjective normative preferences of organizational members. To further this line of reasoning, an opinion survey was conducted at a large research-intensive university to ascertain organizational consensus concerning the normative importance of proposed research output indicators in evaluating the research effectiveness and reputation of three engineering departments. The faculty of these three departments were sampled and key administrators at various levels of the administrative hierarchy at the institution were invited to participate in the survey.

The major findings of the survey were that:

1. There existed considerable lack of consensus within the groups in most instances.

2. The exception to the above observation occurred in the case of published articles, which were considered almost universally as the most important knowledge indicator for judging research effectiveness.

3. Peer judgments of research results were considered as the most important recognition-related indicator with a high level of consensus.

4. The other indicators would be considered to be of secondary importance for the purposes intended.

B. Limitations

The present study, like other studies, was subject to the limitations imposed by current knowledge in the area inquired and by the methodology used.

It was hoped that the literature of social exchange would afford a framework for conceptualizing research output indicators. However, it was found that the specific findings of the major contributions to this body of literature were restricted in scope and therefore in applicability to other situations. It was only possible to make use of the main issues raised by the key figures in this area to analyze higher education research output indicators.

The second part of the study was a case study, and would therefore be subject to the attendant weaknesses of case studies. Lack of experimental control might be cited as a chief offence. This was in some small measure compensated by the random sampling of faculty members and the use of multiple groups. Also, the inclusion of key decision makers in the survey would tend to enhance the realism of the study. Since normative preferences were the subject of investigation, the opinion of individuals in responsible positions would carry considerable weight.

One-shot case studies also suffer from the lack of verifiability, which is not always attainable. The small number of key decision makers and their turnover, among other factors, would tend to thwart attempts to verify subject opinions. In general, organizational changes tend to decrease the verifiability of research conducted in an organizational context. In this particular case, the leadership of one of the department was in transition at the time of the survey, and at least one participant left his position after the survey had been completed.

Another limitation was imposed by the small number of participants in each group, particularly in the administrator groups. This condition and the related issue of large intragroup variation would raise some questions regarding the representativeness of the group means, which were used in the Kruskal-Wallis analysis. To overcome this limitation, the original frequency tables were examined and nonstatistical inferences were made.

To some extent, the limitations would become the opportunities for further research. In the next section, the implications of the limitations and the results are explored.

C. Implications

The present study has a number of implications regarding the selection of performance measures, and the possibility of social exchange theories serving as a broader foundation of accounting.

The Selection of Performance Measures

A practical implication of this study is that, based on the results of the survey, published articles and peer judgments of specific research results would be recommended as the output indicators to be measured. This is at variance with the recommendation of the NCHEMS Outcome Measures Identification Study, which considered research proposals funded and research funding as top-priority items for implementation. To some extent the different recommendations may be explained by the kinds of participants in the respective surveys and by the different questions asked of the participants. It is quite possible that the method of selecting the measures to some extent determine the outcome of the selection. A premise underlying the survey in the present study was that the values of the people whose performance would be evaluated should also have a role in the determination of the criteria of evaluation. From the point of view of the accountant as an information supplier, if it is possible to supply information deemed desirable by all parties concerned, no conflict would arise. However, if a choice has to be made among the conflicting demands, there is a genuine question of whose preferences would prevail. The implication is that at the technical level, the accountant may be objective in the sense of relying on verifiable evidence; however, the choice of evaluative criteria--what is to be measured--is a subjective one.

Social Exchange Theories and Nonfinancial Accounting

This study attempted to utilize the concept of exchange and social exchange theories to explain the existence and operations of research output indicators. It was found that while the concept of social exchange had a great deal of potential, existing theories of social exchange were not readily applicable. By considering the key issues raised in the literature, however, it was possible to formulate a theoretical framework for the indicators. The main conclusions were: economic motives (the desire for resource support), and social motives (social recognition) need not be mutually exclusive. The structure of reciprocity is a network of diffusion and feedback processes. And the valuation of exchange items became the evaluation of research results by peers based on the values and norms of the research community. The implication is that the accounting researcher may be able to apply the general concepts in the social exchange literature to the study of actual phenomena, and at the same time contribute to the development of social exchange theories.

BIBLIOGRAPHY

American Accounting Association, Committee to Prepare a Statement of Basic Accounting Theory. A Statement of Basic Accounting Theory. Evanston, Ill.: American Accounting Association, 1966.

American Institute of Certified Public Accountants, Committee on Terminology. Accounting Terminology Bulletin No. 1. New York: American Institute of Certified Public Accountants, 1953.

American Institute of Certified Public Accountants, Study Group on the Objectives of Financial Statements. Objectives of Financial Statements. New York: American Institute of Certified Public Accountants, 1973.

Barnard, Chester I. The Functions of the Executive. Cambridge, Mass.: Harvard University Press, 1938.

Bavelas, A. "Leadership: Man and Function." Administrative Science Quarterly 4 (March, 1960): 491-498.

Blau, Peter M. Exchange and Power in Social Life. New York: John Wiley & Sons, 1964.

Buck, Vernon E. "A Model for Viewing an Organization as a System of Constraints." In Approaches to Organization Design, pp. 103-172. Edited by James D. Thompson. Pittsburgh: University of Pittsburgh Press, 1966.

Cole, Jonathan, and Cole, Stephen. Social Stratification in Science. Chicago: University of Chicago Press, 1973.

Cyert, Richard, and March, James G. A Behavioral Theory of the Firm. Englewood Cliffs, N.J.: Prentice-Hall, 1963.

Dunn, Olive Jean. "Multiple Comparisons Using Rank Sums." Technometrics 6 (August, 1964): 241-252.

Ekeh, Peter P. Social Exchange Theory: Two Traditions. Cambridge, Mass.: Harvard University Press, 1974.

Etzioni, Amitai. Modern Organizations. Englewood Cliffs, N.J.: Prentice-Hall, 1964.

Frazer, Sir James G. Folklore in the Old Testament, Vol. II. London: Macmillan & Co., 1919.

Georgiou, Petro. "The Goal Paradigm and Notes Toward a Counter Paradigm." Administrative Science Quarterly 18 (September, 1973): 291-310.

Gouldner, Alvin W. "The Norms of Reciprocity." American Sociological Review 25 (April, 1960): 161-178.

Grady, Paul. Inventory of Generally Accepted Accounting Principles for Business Enterprises. New York: American Institute of Certified Public Accountants, 1965.

Greenfield, T. B. "Organizations as Social Inventions: Rethinking Assumptions about Change." Journal of Applied Behavioral Science 9 (September-October, 1973): 551-574.

Gross, Bertram M. Organizations and Their Managing. New York: Free Press, 1968.

Gross, Edward, and Gramsch, Paul V. University Goals and Academic Power. Washington, D.C.: American Council on Education, 1968.

Hagstrom, Warren O. The Scientific Community. New York: Basic Books, 1965.

Hollander, Myles, and Wolfe, Douglas A. Nonparametric Statistical Methods. New York: John Wiley & Sons, 1973.

Homans, George C. Social Behavior: Its Elementary Forms. New York: Harcourt, Brace & World, 1961.

International Encyclopedia of the Social Sciences. Vol. 7. "Interaction: Social Exchange," by Peter M. Blau.

Katz, Daniel, and Kahn, Robert L. The Social Psychology of Organizations. New York: John Wiley & Sons, 1966.

Kim, Jae-On. "Multivariate Analysis of Ordinal Variables." American Journal of Sociology 81 (September, 1975): 261-298.

Langenderfer, Harold Q. "A Conceptual Framework for Financial Accounting." The Journal of Accountancy 136 (July, 1973): 46-55.

Lawrence, Ben; Weathersby, George; and Patterson, Virginia W. eds. Outputs of Higher Education: Their Identification, Measurement, and Evaluation. Boulder, Colo.: Western Interstate Commission for Higher Education, 1970.

Levi-Strauss, Claude. The Elementary Structure of Kinship. Boston: Beacon Press, 1969.

Malinowski, Bronislaw. Argonauts of the Western Pacific. London: Routledge & Kegan Paul, 1922.

Mauss, Marcel. The Gift: Forms and Functions of Exchange in Primitive Societies. Glencoe, Ill.: Free Press, 1954.

Merton, Robert K. Social Theory and Social Structure, enlarged ed. New York: The Free Press, 1968.

Merton, Robert K. The Sociology of Science: Theoretical and Empirical Investigations. Edited by Norman W. Storer. Chicago: University of Chicago Press, 1973.

Merton, Robert K. "Recognition and Excellence: Instructive Ambiguities." In Merton, The Sociology of Science, pp. 419-438.

Merton, Robert K. "The Normative Structure of Science." In Merton, The Sociology of Science, pp. 269-278.

Merton, Robert K. "The Mathew Effect in Science." In Merton, The Sociology of Science, pp. 439-459.

Merton, Robert K., and Zuckerman, Harriet. "Institutionalized Pattern of Evaluation in Science." In Merton, The Sociology of Science, pp. 460-496.

Micek, Sidney S., and Wallhaus, Robert A. An Introduction to the Identification and Uses of Higher Education Outcome Information. Boulder, Colo.: Western Interstate Commission for Higher Education, 1973.

Micek, Sidney S., and Arney, William Ray. The Higher Education Outcome Measures Identification Study: A Descriptive Summary. Boulder, Colo.: National Center for Higher Education Management Systems, 1974.

Micek, Sidney S.; Service, Allan L.; and Lee, Yong S. Outcome Measures and Procedure Manual. Field Ed. Boulder, Colo.: National Center for Higher Education Management Systems, 1975.

National Academy of Sciences--National Academy of Engineering, Committee on Scientific and Technical Communication. Scientific and Technical Communication: A Pressing National Problem and Recommendation for Its Solution. Washington, D.C.: National Academy of Sciences, 1969.

Parsons, Talcott, and Shils, Edwards, eds. Toward a General Theory of Action. Cambridge, Mass.: Harvard University Press, 1951. Harper Torchbook ed., 1962.

Perrow, Charles, "The Analysis of Goals in Complex Organizations." American Sociological Review 26 (December, 1961): 854-866.

Price, Derek J. de Solla. Little Science, Big Science. New York: Columbia University Press, 1963.

Silverman, D. The Theory of Organizations. London: Heinemann, 1970.

Simon, Herbert A. "On the Concept of Organizational Goal." Administrative Science Quarterly 9 (June, 1964): 1-22.

Stinchcombe, Arthur L. Constructing Social Theories. New York: Harcourt, Brace & World, Inc., 1968.

Thompson, James D. Organizations in Action. New York: McGraw-Hill, 1967.

Thompson, James D., and McEwen, William J. "Organizational Goals and Environment: Goal Setting as an Interaction Process." American Sociological Review 23 (February, 1958): 23-31.

Turner, Jonathan H. The Structure of Sociological Theory. Homewood, Ill.: The Dorsey Press, 1974.

Warren, W. Keith, and Havens, A. Eugene. "Goal Displacement and the Intangibility of Organizational Goals." Administrative Science Quarterly 12 (March, 1968): 539-555.

Appendix A

SAMPLE QUESTIONNAIRES
Form A

The Relative Importance of Research Output Indicators

Following is a list of knowledge-related research output indicators and their possible quantitative measures.

Please rank order the indicators (not their quantitative measures) in terms of their importance in judging the effectiveness of your department in conducting research.

The rank order should reflect your own value judgment of what should be the case, as versus what may be or is the case.

Please ignore the order of appearance of the indicators in the list.

Rank	Output Indicators--Knowledge-related
______	Published Articles: Number of articles published per faculty/staff in prestigious journals within a certain time period.
______	Research Reports & Bulletins: Number of research reports and bulletins produced in the department within a certain time period.
______	Dissertations: Number of dissertations produced in the department during a certain time period.
______	Invited Papers: Number of invited papers originating from the department during a certain time period.
______	Research Proposals: Number of research proposals originating from the department during a certain time period.
______	Patents and Copyrights: Number of patents and copyrights received by members of the department during a certain time period.
______	Research Seminars: Number of research seminars sponsored by the department during a certain time period.
______	Commercial Publications: Number of books or monographs written by members of the departments, that are published commercially during a certain time period.

Following is a list of recognition-related research output indicators and their possible quantitative measures.

Please rank order the indicators (not their quantitative measures) in terms of their importance in judging the recognition of excellence of your department in conducting research.

Again, the rank order should reflect your own value judgment of what should be the case, as versus what may be or is the case.

Please ignore the order of appearance of the indicators in the list.

Rank	Output Indicators--Recogniton related
______	Peer Judgment of Specific Research Projects: Judgment of peer groups and/or potential beneficiary groups regarding the worth/impact of research project results.
______	Citations: Number of times a given publication authored by a member of the department is cited in bibliographies of other authors within a certain time period.
______	Invited Papers: Number of invited papers originating from the department during a certain time period.
______	Invitations to Judge Research: Frequency with which members of the department are invited to review articles submitted for possible publication, research proposals, and research reports.
______	Awards and Prizes: Number of awards and citations received by members of the department for their research achievement during a certain time period.
______	Research Proposals Accepted for Funding: Number and percentage of research proposals accepted for funding within a certain time period.
______	Research Funding: The magnitude and percentage of total budget of separately budgeted research in the department.
______	Honorary Election: Number of elections to prestigious national organizations.
______	Department Quality Rating: Ranking among departments in the same discipline in commonly recognized surveys.

SAMPLE QUESTIONNAIRES
Form B

The Relative Importance of Research Output Indicators

Following is a list of knowledge-related research output indicators and their possible quantitative measures.

Please rank order the indicators (not their quantitative measures) in terms of their importance in judging the effectiveness of a [name of institution] engineering department in conducting research.

The rank order should reflect your own value judgment of what should be the case, as versus what may be or is the case.

Please ignore the order of appearance of the indicators in the list.

Rank	Output Indicators--Knowledge-related
______	Published Articles: Number of articles published per faculty/staff in prestigious journals within a certain time period.
______	Research Reports & Bulletins: Number of research reports and bulletins produced in the department within a certain time period.
______	Dissertations: Number of dissertations produced in the department during a certain time period.
______	Invited Papers: Number of invited papers originating from the department during a certain time period.
______	Research Proposals: Number of research proposals originating from the department during a certain time period.
______	Patents and Copyrights: Number of patents and copyrights received by members of the department during a certain time period.
______	Research Seminars: Number of research seminars sponsored by the department during a certain time period.
______	Commercial Publications: Number of books or monographs written by members of the departments, that are published commercially during a certain time period.

Following is a list of recognition-related research output indicators and their possible quantitative measures.

Please rank order the indicators (not their quantitative measures) in terms of their importance in judging the recognition of excellence of a [name of institution] engineering department in conducting research.

Again, the rank order should reflect your own value judgment of what <u>should be</u> the case, as versus what may be or is the case.

Please ignore the order of appearance of the indicators in the list.

Rank	Output Indicators--Recognition-related
______	<u>Peer Judgment of Specific Research Projects</u>: Judgment of peer groups and/or potential beneficiary groups regarding the worth/impact of research project results.
______	<u>Citations</u>: Number of times a given publication authored by a member of the department is cited in bibliographies of other authors within a certain time period.
______	<u>Invited Papers</u>: Number of invited papers originating from the department during a certain time period.
______	<u>Invitations to Judge Research</u>: Frequency with which members of the department are invited to review articles submitted for possible publication, research proposals, and research reports.
______	<u>Awards and Prizes</u>: Number of awards and citations received by members of the department for their research achievement during a certain time period.
______	<u>Research Proposals Accepted for Funding</u>: Number and percentage of research proposals accepted for funding within a certain time period.
______	<u>Research Funding</u>: The magnitude and percentage of total budget of separately budgeted research in the department.
______	<u>Honorary Election</u>: Number of elections to prestigious national organizations.
______	<u>Department Quality Rating</u>: Ranking among departments in the same discipline in commonly recognized surveys.

Appendix B

RESULTS OF THE KRUSKAL-WALLIS TEST AND OF DUNN'S MULTIPLE COMPARISONS

K1: PUBLISHED ARTICLES

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
CE.FAC	8	3	1	0	0	0	0	0	0	12
EE.FAC	6	2	0	0	0	1	0	0	0	9
MIE.FAC	5	2	0	0	0	0	0	0	0	7
COL TOTL	19	7	1	0	0	1	0	0	0	28
AV. RANK	10.0	23.0	27.0	0.0	0.0	28.0	0.0	0.0	0.0	

UNCORRECTED H= 0.09 CORRECTION FACTOR=.67 H= 0.13

AN H= 0.13 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.95 > P > .90

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
CE.FAC	8	3	1	0	0	0	0	0	0	12
CE.ADM	3	0	0	0	0	0	0	0	0	3
COLL.ADM	2	0	0	0	0	0	0	0	0	2
CAMP.ADM	2	0	0	0	0	0	0	0	0	2
UNIV.ADM	0	1	0	1	0	0	0	0	0	2
COL TOTL	15	4	1	1	0	0	0	0	0	21
AV. RANK	8.0	17.5	20.0	21.0	0.0	0.0	0.0	0.0	0.0	

UNCORRECTED H= 5.22 CORRECTION FACTOR=.63 H= 8.28

AN H= 8.28 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
CE.FAC	CE.ADM	3.37	3.178	1.060	MAY BE 0
CE.FAC	COLL.ADM	3.37	3.760	0.896	MAY BE 0
CE.FAC	CAMP.ADM	3.37	3.760	0.896	MAY BE 0
CE.FAC	UNIV.ADM	-7.87	3.760	-2.093	MAY BE 0
CE.ADM	COLL.ADM	0.00	4.494	0.000	MAY BE 0
CE.ADM	CAMP.ADM	0.00	4.494	0.000	MAY BE 0
CE.ADM	UNIV.ADM	-11.25	4.494	-2.503	MAY BE 0
COLL.ADM	CAMP.ADM	0.00	4.923	0.000	MAY BE 0.
COLL.ADM	UNIV.ADM	-11.25	4.923	-2.285	MAY BE 0
CAMP.ADM	UNIV.ADM	-11.25	4.923	-2.285	MAY BE 0

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
EE.FAC	6	2	0	0	0	1	0	0	0	9
EE.ADM	1	1	0	0	0	0	0	0	0	2
COLL.ADM	2	0	0	0	0	0	0	0	0	2
CAMP.ADM	2	0	0	0	0	0	0	0	0	2
UNIV.ADM	0	1	0	1	0	0	0	0	0	2
COL TOTL	11	4	0	1	0	1	0	0	0	17
AV. RANK	6.0	13.5	0.0	16.0	0.0	17.0	0.0	0.0	0.0	

UNCORRECTED H= 4.05 CORRECTION FACTOR=.72 H= 5.64

AN H= 5.64 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
MIE.FAC	5	2	0	0	0	0	0	0	0	7
MIE.ADM	3	0	0	0	0	0	0	0	0	3
COLL.ADM	2	0	0	0	0	0	0	0	0	2
CAMP.ADM	2	0	0	0	0	0	0	0	0	2
UNIV.ADM	0	1	0	1	0	0	0	0	0	2
COL TOTL	12	3	0	1	0	0	0	0	0	16
AV. RANK	6.5	14.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	

UNCORRECTED H= 4.97 CORRECTION FACTOR=.57 H= 8.66

AN H= 8.66 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
MIE.FAC	MIE.ADM	2.14	2.487	0.860	MAY BE 0
MIE.FAC	COLL.ADM	2.14	2.890	0.740	MAY BE 0
MIE.FAC	CAMP.ADM	2.14	2.890	0.740	MAY BE 0
MIE.FAC	UNIV.ADM	-6.35	2.890	-2.197	MAY BE 0
MIE.ADM	COLL.ADM	0.00	3.290	0.000	MAY BE 0
MIE.ADM	CAMP.ADM	0.00	3.290	0.000	MAY BE 0
MIE.ADM	UNIV.ADM	-8.50	3.290	-2.583	IS < 0
COLL.ADM	CAMP.ADM	0.00	3.604	0.000	MAY BE 0
COLL.ADM	UNIV.ADM	-8.50	3.604	-2.358	MAY BE 0
CAMP.ADM	UNIV.ADM	-8.50	3.604	-2.358	MAY BE 0

K2: RESEARCH REPORTS & BULLETINS

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	3	0	4	2	2	1	0	0	12
EE.FAC	1	1	0	0	2	2	3	0	0	9
MIE.FAC	1	0	3	1	2	0	0	0	0	7
COL TOTL	2	4	3	5	6	4	4	0	0	28
AV. RANK	1.5	4.5	8.0	12.0	17.5	22.5	26.5	0.0	0.0	

UNCORRECTED H= 3.83 CORRECTION FACTOR=.98 H= 3.93

AN H= 3.93 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	3	0	4	2	2	1	0	0	12
CE.ADM	0	1	2	0	0	0	0	0	0	3
COLL.ADM	0	0	0	0	0	0	2	0	0	2
CAMP.ADM	0	0	0	0	0	1	0	1	0	2
UNIV.ADM	0	0	0	0	0	2	0	0	0	2
COL TOTL	0	4	2	4	2	5	3	1	0	21
AV. RANK	0.0	2.5	5.5	8.5	11.5	15.0	19.0	21.0	0.0	

UNCORRECTED H= 10.73 CORRECTION FACTOR=.97 H= 11.06

AN H=11.06 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.05 > P > .02

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM DUNNS MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
CE.FAC	CE.ADM	4.95	3.944	1.255	MAY BE 0
CE.FAC	COLL.ADM	-9.54	4.667	-2.044	MAY BE 0
CE.FAC	CAMP.ADM	-8.54	4.667	-1.829	MAY BE 0
CE.FAC	UNIV.ADM	-5.54	4.667	-1.187	MAY BE 0
CE.ADM	COLL.ADM	-14.50	5.578	-2.599	IS < 0
CE.ADM	CAMP.ADM	-13.50	5.578	-2.420	MAY BE 0
CE.ADM	UNIV.ADM	-10.50	5.578	-1.882	MAY BE 0
COLL.ADM	CAMP.ADM	1.00	6.110	0.163	MAY BE 0
COLL.ADM	UNIV.ADM	4.00	6.110	0.654	MAY BE 0
CAMP.ADM	UNIV.ADM	3.00	6.110	0.490	MAY BE 0

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	1	1	0	0	2	2	3	0	0	9
EE.ADM	0	0	0	1	1	0	0	0	0	2
COLL.ADM	0	0	0	0	0	0	2	0	0	2
CAMP.ADM	0	0	0	0	0	1	0	1	0	2
UNIV.ADM	0	0	0	0	0	2	0	0	0	2
COL TOTL	1	1	0	1	3	5	5	1	0	17
AV. RANK	1.0	2.0	0.0	3.0	5.0	9.0	14.0	17.0	0.0	

(Column headings 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 5.46 CORRECTION FACTOR=.95 H= 5.77

AN H= 5.77 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	1	0	3	1	2	0	0	0	0	7
MIE.ADM	0	0	0	1	0	1	1	0	0	3
COLL.ADM	0	0	0	0	0	0	2	0	0	2
CAMP.ADM	0	0	0	0	0	1	0	1	0	2
UNIV.ADM	0	0	0	0	0	2	0	0	0	2
COL TOTL	1	0	3	2	2	4	3	1	0	16
AV. RANK	1.0	0.0	3.0	5.5	7.5	10.5	14.0	16.0	0.0	

(Column headings 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 10.61 CORRECTION FACTOR=.97 H= 10.93

AN H=10.93 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.05 > P > .02

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM DUNNS MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
MIE.FAC	MIE.ADM	-5.64	3.236	-1.742	MAY BE 0
MIE.FAC	COLL.ADM	-9.64	3.760	-2.563	MAY BE 0
MIE.FAC	CAMP.ADM	-8.89	3.760	-2.364	MAY BE 0
MIE.FAC	UNIV.ADM	-6.14	3.760	-1.632	MAY BE 0
MIE.ADM	COLL.ADM	-4.00	4.281	-0.934	MAY BE 0
MIE.ADM	CAMP.ADM	-3.25	4.281	-0.759	MAY BE 0
MIE.ADM	UNIV.ADM	-0.50	4.281	-0.116	MAY BE 0
COLL.ADM	CAMP.ADM	0.75	4.689	0.159	MAY BE 0
COLL.ADM	UNIV.ADM	3.50	4.689	0.746	MAY BE 0
CAMP.ADM	UNIV.ADM	2.75	4.689	0.586	MAY BE 0

K3: DISSERTATIONS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
CE.FAC	2	1	6	2	0	1	0	0	0	12
EE.FAC	1	4	3	1	0	0	0	0	0	9
MIE.FAC	0	2	0	3	1	0	0	1	0	7
COL TOTL	3	7	9	6	1	1	0	1	0	28
AV. RANK	2.0	7.0	15.0	22.5	26.0	27.0	0.0	28.0	0.0	

UNCORRECTED H= 4.23 CORRECTION FACTOR=.94 H= 4.49

AN H= 4.49 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
CE.FAC	2	1	6	2	0	1	0	0	0	12
CE.ADM	0	0	0	3	0	0	0	0	0	3
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	0	0	1	0	0	0	1	0	0	2
UNIV.ADM	0	0	0	0	1	0	1	0	0	2
COL TOTL	2	2	8	5	1	1	2	0	0	21
AV. RANK	1.5	3.5	8.5	15.0	18.0	19.0	20.5	0.0	0.0	

UNCORRECTED H= 8.12 CORRECTION FACTOR=.93 H= 8.73

AN H= 8.73 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM DUNNS MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
CE.FAC	CE.ADM	-6.12	3.863	-1.584	MAY BE 0
CE.FAC	COLL.ADM	2.87	4.571	0.627	MAY BE 0
CE.FAC	CAMP.ADM	-5.62	4.571	-1.229	MAY BE 0
CE.FAC	UNIV.ADM	-10.37	4.571	-2.268	MAY BE 0
CE.ADM	COLL.ADM	9.00	5.463	1.647	MAY BE 0
CE.ADM	CAMP.ADM	0.50	5.463	0.091	MAY BE 0
CE.ADM	UNIV.ADM	-4.25	5.463	-0.777	MAY BF 0
COLL.ADM	CAMP.ADM	-8.50	5.984	-1.420	MAY BE 0
COLL.ADM	UNIV.ADM	-13.25	5.984	-2.214	MAY BE 0
CAMP.ADM	UNIV.ADM	-4.75	5.984	-0.793	MAY BE 0

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
EE.FAC	1	4	3	1	0	0	0	0	0	9
EE.ADM	0	1	1	0	0	0	0	0	0	2
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	0	0	1	0	0	0	1	0	0	2
UNIV.ADM	0	0	0	0	1	0	1	0	0	2
COL TOTL	1	6	6	1	1	0	2	0	0	17
AV. RANK	1.0	4.5	10.5	14.0	15.0	0.0	16.5	0.0	0.0	

UNCORRECTED H= 6.70 CORRECTION FACTOR=.91 H= 7.34

AN H= 7.34 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
MIE.FAC	0	2	0	3	1	0	0	1	0	7
MIE.ADM	0	1	0	0	2	0	0	0	0	3
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	0	0	1	0	0	0	1	0	0	2
UNIV.ADM	0	0	0	0	1	0	1	0	0	2
COL TOTL	0	4	2	3	4	0	2	1	0	16
AV. RANK	0.0	2.5	5.5	8.0	11.5	0.0	14.5	16.0	0.0	

UNCORRECTED H= 3.83 CORRECTION FACTOR=.96 H= 3.98

AN H= 3.98 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

K4: INVITED PAPERS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
CE.FAC	2	2	2	5	1	0	0	0	0	12
EE.FAC	1	0	2	3	1	2	0	0	0	9
MIE.FAC	1	1	0	0	3	2	0	0	0	7
COL TOTL	4	3	4	8	5	4	0	0	0	28
AV. RANK	2.5	6.0	9.5	15.5	22.0	26.5	0.0	0.0	0.0	

UNCORRECTED H= 3.51 CORRECTION FACTOR=.96 H= 3.65

AN H= 3.65 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	2	2	2	5	1	0	0	0	0	12
CE.ADM	0	2	1	0	0	0	0	0	0	3
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	0	1	1	0	0	0	0	0	0	2
UNIV.ADM	1	0	1	0	0	0	0	0	0	2
COL TOTL	3	6	6	5	1	0	0	0	0	21
AV. RANK	2.0	6.5	12.5	18.0	21.0	0.0	0.0	0.0	0.0	

UNCORRECTED H= 2.41 CORRECTION FACTOR=.94 H= 2.56

AN H= 2.56 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.70 > P > .50

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	1	0	2	3	1	2	0	0	0	9
EE.ADM	1	0	1	0	0	0	0	0	0	2
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	0	1	1	0	0	0	0	0	0	2
UNIV.ADM	1	0	1	0	0	0	0	0	0	2
COL TOTL	3	2	6	3	1	2	0	0	0	17
AV. RANK	2.0	4.5	8.5	13.0	15.0	16.5	0.0	0.0	0.0	

UNCORRECTED H= 5.91 CORRECTION FACTOR=.94 H= 6.25

AN H= 6.25 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	1	1	0	0	3	2	0	0	0	7
MIE.ADM	0	1	2	0	0	0	0	0	0	3
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	0	1	1	0	0	0	0	0	0	2
UNIV.ADM	1	0	1	0	0	0	0	0	0	2
COL TOTL	2	4	5	0	3	2	0	0	0	16
AV. RANK	1.5	4.5	9.0	0.0	13.0	15.5	0.0	0.0	0.0	

UNCORRECTED H= 3.32 CORRECTION FACTOR=.95 H= 3.51

AN H= 3.51 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

K5: RESEARCH PROPOSALS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
CE.FAC	0	0	2	0	3	1	4	2	0	12
EE.FAC	0	1	1	0	3	1	0	3	0	9
MIE.FAC	0	0	0	0	0	3	4	0	0	7
COL TOTL	0	1	3	0	6	5	8	5	0	28
AV. RANK	0.0	1.0	3.0	0.0	7.5	13.0	19.5	26.0	0.0	

UNCORRECTED H= 0.79 CORRECTION FACTOR=.96 H= 0.83

AN H= 0.83 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.70 > P > .50

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
CE.FAC	0	0	2	0	3	1	4	2	0	12
CE.ADM	0	0	0	0	2	1	0	0	0	3
COLL.ADM	0	0	0	0	1	1	0	0	0	2
CAMP.ADM	0	0	0	1	1	0	0	0	0	2
UNIV.ADM	0	1	0	1	0	0	0	0	0	2
COL TOTL	0	1	2	2	7	3	4	2	0	21
AV. RANK	0.0	1.0	2.5	4.5	9.0	14.0	17.5	20.5	0.0	

UNCORRECTED H= 5.85 CORRECTION FACTOR=.95 H= 6.14

AN H= 6.14 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
EE.FAC	0	1	1	0	3	1	0	3	0	9
EE.ADM	0	0	0	1	0	1	0	0	0	2
COLL.ADM	0	0	0	0	1	1	0	0	0	2
CAMP.ADM	0	0	0	1	1	0	0	0	0	2
UNIV.ADM	0	1	0	1	0	0	0	0	0	2
COL TOTL	0	2	1	3	5	3	0	3	0	17
AV. RANK	0.0	1.5	3.0	5.0	9.0	13.0	0.0	16.0	0.0	

UNCORRECTED H= 3.80 CORRECTION FACTOR=.96 H= 3.96

AN H= 3.96 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
MIE.FAC	0	0	0	0	0	3	4	0	0	7
MIE.ADM	0	1	1	0	0	0	1	0	0	3
COLL.ADM	0	0	0	0	1	1	0	0	0	2
CAMP.ADM	0	0	0	1	1	0	0	0	0	2
UNIV.ADM	0	1	0	1	0	0	0	0	0	2
COL TOTL	0	2	1	2	2	4	5	0	0	16
AV. RANK	0.0	1.5	3.0	4.5	6.5	9.5	14.0	0.0	0.0	

UNCORRECTED H= 8.14 CORRECTION FACTOR=.95 H= 8.56

AN H= 8.56 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
MIE.FAC	MIE.ADM	5.90	3.203	1.842	MAY BE 0
MIE.FAC	COLL.ADM	4.07	3.722	1.093	MAY BE 0
MIE.FAC	CAMP.ADM	6.57	3.722	1.765	MAY BE 0
MIE.FAC	UNIV.ADM	9.07	3.722	2.436	MAY BE 0
MIE.ADM	COLL.ADM	-1.83	4.238	-0.431	MAY BE 0
MIE.ADM	CAMP.ADM	0.66	4.238	0.155	MAY BE 0
MIE.ADM	UNIV.ADM	3.16	4.238	0.745	MAY BE 0
COLL.ADM	CAMP.ADM	2.50	4.642	0.538	MAY BE 0
COLL.ADM	UNIV.ADM	5.00	4.642	1.077	MAY BE 0
CAMP.ADM	UNIV.ADM	2.50	4.642	0.538	MAY BE 0

K6: PATENTS & COPYRIGHTS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
CE.FAC	0	0	1	0	0	4	1	6	0	12
EE.FAC	0	0	2	1	0	2	2	2	0	9
MIE.FAC	0	0	1	0	1	0	0	5	0	7
COL TOTL	0	0	4	1	1	6	3	13	0	28
AV. RANK	0.0	0.0	2.5	5.0	6.0	9.5	14.0	22.0	0.0	

UNCORRECTED H= 2.23 CORRECTION FACTOR=.89 H= 2.52

AN H= 2.52 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	0	1	0	0	4	1	6	0	12
CE.ADM	0	0	0	0	0	0	2	1	0	3
COLL.ADM	0	0	0	0	0	0	0	2	0	2
CAMP.ADM	0	1	0	0	0	0	1	0	0	2
UNIV.ADM	1	0	1	0	0	0	0	0	0	2
COL TOTL	1	1	2	0	0	4	4	9	0	21
AV. RANK	1.0	2.0	3.5	0.0	0.0	6.5	10.5	17.0	0.0	

(FREQUENCY OF RANKS)

UNCORRECTED H= 7.45 CORRECTION FACTOR=.91 H= 8.20

AN H= 8.20 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
CE.FAC	CE.ADM	-0.83	3.816	-0.217	MAY BE 0
CE.FAC	COLL.ADM	-5.16	4.516	-1.142	MAY BE 0
CE.FAC	CAMP.ADM	5.58	4.516	1.235	MAY BE 0
CE.FAC	UNIV.ADM	9.58	4.516	2.121	MAY BE 0
CE.ADM	COLL.ADM	-4.33	5.397	-0.802	MAY BE 0
CE.ADM	CAMP.ADM	6.41	5.397	1.187	MAY BE 0
CE.ADM	UNIV.ADM	10.41	5.397	1.928	MAY BE 0
COLL.ADM	CAMP.ADM	10.75	5.912	1.818	MAY BE 0
COLL.ADM	UNIV.ADM	14.75	5.912	2.494	MAY BE 0
CAMP.ADM	UNIV.ADM	4.00	5.912	0.676	MAY BE 0

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	0	0	2	1	0	2	2	2	0	9
EE.ADM	0	0	0	0	0	1	0	1	0	2
COLL.ADM	0	0	0	0	0	0	0	2	0	2
CAMP.ADM	0	1	0	0	0	0	1	0	0	2
UNIV.ADM	1	0	1	0	0	0	0	0	0	2
COL TOTL	1	1	3	1	0	3	3	5	0	17
AV. RANK	1.0	2.0	4.0	6.0	0.0	8.0	11.0	15.0	0.0	

(FREQUENCY OF RANKS)

UNCORRECTED H= 7.12 CORRECTION FACTOR=.96 H= 7.41

AN H= 7.41 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	0	0	1	0	1	0	0	5	0	7
MIE.ADM	0	0	0	1	0	0	1	1	0	3
COLL.ADM	0	0	0	0	0	0	0	2	0	2
CAMP.ADM	0	1	0	0	0	0	1	0	0	2
UNIV.ADM	1	0	1	0	0	0	0	0	0	2
COL TOTL	1	1	2	1	1	0	2	8	0	16
AV. RANK	1.0	2.0	3.5	5.0	6.0	0.0	7.5	12.5	0.0	

(FREQUENCY OF RANKS: columns 1–9)

UNCORRECTED H= 7.09 CORRECTION FACTOR=.87 H= 8.11

AN H= 8.11 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
MIE.FAC	MIE.ADM	1.95	3.070	0.635	MAY BE 0
MIE.FAC	COLL.ADM	-2.21	3.567	-0.619	MAY BE 0
MIE.FAC	CAMP.ADM	5.53	3.567	1.550	MAY BE 0
MIE.FAC	UNIV.ADM	8.03	3.567	2.251	MAY BE 0
MIE.ADM	COLL.ADM	-4.16	4.061	-1.024	MAY BE 0
MIE.ADM	CAMP.ADM	3.58	4.061	0.881	MAY BE 0
MIE.ADM	UNIV.ADM	6.08	4.061	1.497	MAY BE 0
COLL.ADM	CAMP.ADM	7.75	4.448	1.742	MAY BE 0
COLL.ADM	UNIV.ADM	10.25	4.448	2.304	MAY BE 0
CAMP.ADM	UNIV.ADM	2.50	4.448	0.562	MAY BE 0

K7: RESEARCH SEMINARS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	0	0	0	3	4	3	2	0	12
EE.FAC	0	0	0	3	2	1	1	2	0	9
MIE.FAC	0	0	0	2	0	2	3	0	0	7
COL TOTL	0	0	0	5	5	7	7	4	0	28
AV. RANK	0.0	0.0	0.0	3.0	8.0	14.0	21.0	26.5	0.0	

(FREQUENCY OF RANKS: columns 1–9)

UNCORRECTED H= 1.14 CORRECTION FACTOR=.96 H= 1.19

AN H= 1.19 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.70 > P > .50

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	0	0	0	3	4	3	2	0	12
CE.ADM	0	0	0	0	0	1	1	1	0	3
COLL.ADM	0	0	0	1	1	0	0	0	0	2
CAMP.ADM	0	0	0	0	0	1	0	1	0	2
UNIV.ADM	0	0	0	0	0	0	0	2	0	2
COL TOTL	0	0	0	1	4	6	4	6	0	21
AV. RANK	0.0	0.0	0.0	1.0	3.5	8.5	13.5	18.5	0.0	

UNCORRECTED H= 7.93 CORRECTION FACTOR=.94 H= 8.42

AN H= 8.42 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
CE.FAC	CE.ADM	-3.33	3.885	-0.857	MAY BE 0
CE.FAC	COLL.ADM	7.91	4.597	1.720	MAY BE 0
CE.FAC	CAMP.ADM	-3.33	4.597	-0.724	MAY BE 0
CE.FAC	UNIV.ADM	-8.33	4.597	-1.812	MAY BE 0
CE.ADM	COLL.ADM	11.25	5.495	2.047	MAY BE 0
CE.ADM	CAMP.ADM	0.00	5.495	0.000	MAY BE 0
CE.ADM	UNIV.ADM	-5.00	5.495	-0.909	MAY BE 0
COLL.ADM	CAMP.ADM	-11.25	6.019	-1.869	MAY BE 0
COLL.ADM	UNIV.ADM	-16.25	6.019	-2.699	IS < 0
CAMP.ADM	UNIV.ADM	-5.00	6.019	-0.830	MAY BE 0

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	0	0	0	3	2	1	1	2	0	9
EE.ADM	0	0	0	0	1	0	1	0	0	2
COLL.ADM	0	0	0	1	1	0	0	0	0	2
CAMP.ADM	0	0	0	0	0	1	0	1	0	2
UNIV.ADM	0	0	0	0	0	0	0	2	0	2
COL TOTL	0	0	0	4	4	2	2	5	0	17
AV. RANK	0.0	0.0	0.0	2.5	6.5	9.5	11.5	15.0	0.0	

UNCORRECTED H= 5.63 CORRECTION FACTOR=.95 H= 5.94

AN H= 5.94 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	0	0	0	2	0	2	3	0	0	7
MIE.ADM	0	0	0	0	1	2	0	0	0	3
COLL.ADM	0	0	0	1	1	0	0	0	0	2
CAMP.ADM	0	0	0	0	0	1	0	1	0	2
UNIV.ADM	0	0	0	0	0	0	0	2	0	2
COL TOTL	0	0	0	3	2	5	3	3	0	16
AV. RANK	0.0	0.0	0.0	2.0	4.5	8.0	12.0	15.0	0.0	

UNCORRECTED H= 7.40 CORRECTION FACTOR=.95 H= 7.78

AN H= 7.78 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

K8: COMMERCIAL PUBLICATIONS

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	3	1	0	3	0	3	2	0	12
EE.FAC	0	1	1	1	1	0	3	2	0	9
MIE.FAC	0	2	3	1	0	0	0	1	0	7
COL TOTL	0	6	5	2	4	0	6	5	0	28
AV. RANK	0.0	3.5	9.0	12.5	15.5	0.0	20.5	26.0	0.0	

UNCORRECTED H= 2.72 CORRECTION FACTOR=.97 H= 2.81

AN H= 2.81 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	3	1	0	3	0	3	2	0	12
CE.ADM	0	0	0	0	1	1	0	1	0	3
COLL.ADM	0	0	0	1	0	1	0	0	0	2
CAMP.ADM	0	0	0	1	1	0	0	0	0	2
UNIV.ADM	0	0	0	0	1	0	1	0	0	2
COL TOTL	0	3	1	2	6	2	4	3	0	21
AV. RANK	0.0	2.0	4.0	5.5	9.5	13.5	16.5	20.0	0.0	

UNCORRECTED H= 1.86 CORRECTION FACTOR=.96 H= 1.93

AN H= 1.93 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.80 > P > .70

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
EE.FAC	0	1	1	1	1	0	3	2	0	9
EE.ADM	0	0	0	0	0	0	1	1	0	2
COLL.ADM	0	0	0	1	0	1	0	0	0	2
CAMP.ADM	0	0	0	1	1	0	0	0	0	2
UNIV.ADM	0	0	0	0	1	0	1	0	0	2
COL TOTL	0	1	1	3	3	1	5	3	0	17
AV. RANK	0.0	1.0	2.0	4.0	7.0	9.0	12.0	16.0	0.0	

UNCORRECTED H= 3.44 CORRECTION FACTOR=.96 H= 3.58

AN H= 3.58 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
MIE.FAC	0	2	3	1	0	0	0	1	0	7
MIE.ADM	0	0	0	1	0	0	0	2	0	3
COLL.ADM	0	0	0	1	0	1	0	0	0	2
CAMP.ADM	0	0	0	1	1	0	0	0	0	2
UNIV.ADM	0	0	0	0	1	0	1	0	0	2
COL TOTL	0	2	3	4	2	1	1	3	0	16
AV. RANK	0.0	1.5	4.0	7.5	10.5	12.0	13.0	15.0	0.0	

UNCORRECTED H= 6.26 CORRECTION FACTOR=.97 H= 6.45

AN H= 6.45 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

R1: PEER JUDGMENT OF SPECIFIC RESEARCH PROJECTS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
CE.FAC	7	2	1	1	1	0	0	0	0	12
EE.FAC	6	2	0	0	0	1	0	0	0	9
MIE.FAC	3	1	0	0	1	0	1	0	1	7
COL TOTL	16	5	1	1	2	1	1	0	1	28
AV. RANK	8.5	19.0	22.0	23.0	24.5	26.0	27.0	0.0	28.0	

UNCORRECTED H= 1.52 CORRECTION FACTOR=.81 H= 1.88

AN H= 1.88 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
CE.FAC	7	2	1	1	1	0	0	0	0	12
CE.ADM	3	0	0	0	0	0	0	0	0	3
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	2	0	0	0	0	0	0	0	0	2
UNIV.ADM	1	0	0	1	0	0	0	0	0	2
COL TOTL	13	3	2	2	1	0	0	0	0	21
AV. RANK	7.0	15.0	17.5	19.5	21.0	0.0	0.0	0.0	0.0	

UNCORRECTED H= 3.83 CORRECTION FACTOR=.76 H= 5.04

AN H= 5.04 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
EE.FAC	6	2	0	0	0	1	0	0	0	9
EE.ADM	0	1	0	0	0	0	0	1	0	2
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	2	0	0	0	0	0	0	0	0	2
UNIV.ADM	1	0	0	1	0	0	0	0	0	2
COL TOTL	9	4	1	1	0	1	0	1	0	17
AV. RANK	5.0	11.5	14.0	15.0	0.0	16.0	0.0	17.0	0.0	

UNCORRECTED H= 5.23 CORRECTION FACTOR=.84 H= 6.22

AN H= 6.22 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
				FREQUENCY OF RANKS						
MIE.FAC	3	1	0	0	1	0	1	0	1	7
MIE.ADM	2	0	0	0	1	0	0	0	0	3
COLL.ADM	0	1	1	0	0	0	0	0	0	2
CAMP.ADM	2	0	0	0	0	0	0	0	0	2
UNIV.ADM	1	0	0	1	0	0	0	0	0	2
COL TOTL	8	2	1	1	2	0	1	0	1	16
AV. RANK	4.5	9.5	11.0	12.0	13.5	0.0	15.0	0.0	16.0	

UNCORRECTED H= 2.22 CORRECTION FACTOR=.87 H= 2.54

AN H= 2.54 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.70 > P > .50

R2: CITATIONS

GROUPS	FREQUENCY OF RANKS									ROW
COMPARED	1	2	3	4	5	6	7	8	9	TOTL
CE.FAC	1	1	2	0	5	0	0	2	1	12
EE.FAC	0	1	1	1	1	2	0	1	2	9
MIE.FAC	1	0	2	0	1	1	1	1	0	7
COL TOTL	2	2	5	1	7	3	1	4	3	28
AV. RANK	1.5	3.5	7.0	10.0	14.0	19.0	21.0	23.5	27.0	

UNCORRECTED H= 0.93 CORRECTION FACTOR=.97 H= 0.95

AN H= 0.95 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.70 > P > .50

GROUPS	FREQUENCY OF RANKS									ROW
COMPARED	1	2	3	4	5	6	7	8	9	TOTL
CE.FAC	1	1	2	0	5	0	0	2	1	12
CE.ADM	0	1	0	0	0	0	0	0	2	3
COLL.ADM	0	0	0	0	2	0	0	0	0	2
CAMP.ADM	0	0	0	2	0	0	0	0	0	2
UNIV.ADM	0	0	0	0	1	1	0	0	0	2
COL TOTL	1	2	2	2	8	1	0	2	3	21
AV. RANK	1.0	2.5	4.5	6.5	11.5	16.0	0.0	17.5	20.0	

UNCORRECTED H= 2.35 CORRECTION FACTOR=.94 H= 2.49

AN H= 2.49 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.70 > P > .50

GROUPS	FREQUENCY OF RANKS									ROW
COMPARED	1	2	3	4	5	6	7	8	9	TOTL
EE.FAC	0	1	1	1	1	2	0	1	2	9
EE.ADM	0	0	0	0	0	0	1	0	1	2
COLL.ADM	0	0	0	0	2	0	0	0	0	2
CAMP.ADM	0	0	0	2	0	0	0	0	0	2
UNIV.ADM	0	0	0	0	1	1	0	0	0	2
COL TOTL	0	1	1	3	4	3	1	1	3	17
AV. RANK	0.0	1.0	2.0	4.0	7.5	11.0	13.0	14.0	16.0	

UNCORRECTED H= 4.52 CORRECTION FACTOR=.97 H= 4.65

AN H= 4.65 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	1	0	2	0	1	1	1	1	0	7
MIE.ADM	0	0	0	1	0	0	0	2	0	3
COLL.ADM	0	0	0	0	2	0	0	0	0	2
CAMP.ADM	0	0	0	2	0	0	0	0	0	2
UNIV.ADM	0	0	0	0	1	1	0	0	0	2
COL TOTL	1	0	2	3	4	2	1	3	0	16
AV. RANK	1.0	0.0	2.5	5.0	8.5	11.5	13.0	15.0	0.0	

(Columns 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 2.80 CORRECTION FACTOR=.97 H= 2.88

AN H= 2.88 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.70 > P > .50

R3: INVITED PAPERS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	1	0	1	4	1	1	4	0	0	12
EE.FAC	0	1	1	2	1	1	0	2	1	9
MIE.FAC	1	0	0	3	0	0	1	1	1	7
COL TOTL	2	1	2	9	2	2	5	3	2	28
AV. RANK	1.5	3.0	4.5	10.0	15.5	17.5	21.0	25.0	27.5	

(Columns 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 0.27 CORRECTION FACTOR=.96 H= 0.28

AN H= 0.28 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.90 > P > .80

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	1	0	1	4	1	1	4	0	0	12
CE.ADM	0	0	2	1	0	0	0	0	0	3
COLL.ADM	0	0	1	0	0	1	0	0	0	2
CAMP.ADM	0	1	0	0	1	0	0	0	0	2
UNIV.ADM	0	0	0	1	0	0	1	0	0	2
COL TOTL	1	1	4	6	2	2	5	0	0	21
AV. RANK	1.0	2.0	4.5	9.5	13.5	15.5	19.0	0.0	0.0	

(Columns 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 3.56 CORRECTION FACTOR=.96 H= 3.72

AN H= 3.72 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	0	1	1	2	1	1	0	2	1	9
EE.ADM	0	0	1	0	0	1	0	0	0	2
COLL.ADM	0	0	1	0	0	1	0	0	0	2
CAMP.ADM	0	1	0	0	1	0	0	0	0	2
UNIV.ADM	0	0	0	1	0	0	1	0	0	2
COL TOTL	0	2	3	3	2	3	1	2	1	17
AV. RANK	0.0	1.5	4.0	7.0	9.5	12.0	14.0	15.5	17.0	

(Columns 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 1.57 CORRECTION FACTOR=.98 H= 1.60

AN H= 1.60 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.90 > P > .80

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	1	0	0	3	0	0	1	1	1	7
MIE.ADM	0	0	0	0	0	0	2	0	1	3
COLL.ADM	0	0	1	0	0	1	0	0	0	2
CAMP.ADM	0	1	0	0	1	0	0	0	0	2
UNIV.ADM	0	0	0	1	0	0	1	0	0	2
COL TOTL	1	1	1	4	1	1	4	1	2	16
AV. RANK	1.0	2.0	3.0	5.5	8.0	9.0	11.5	14.0	15.5	

(Columns 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 4.12 CORRECTION FACTOR=.97 H= 4.25

AN H= 4.25 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

R4: INVITATIONS TO JUDGE RESEARCH

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	1	0	0	0	1	1	3	2	4	12
EE.FAC	0	1	0	2	1	0	2	2	1	9
MIE.FAC	0	0	2	0	0	3	0	1	1	7
COL TOTL	1	1	2	2	2	4	5	5	6	28
AV. RANK	1.0	2.0	3.5	5.5	7.5	10.5	15.0	20.0	25.5	

(Columns 1–9: FREQUENCY OF RANKS)

UNCORRECTED H= 2.25 CORRECTION FACTOR=.98 H= 2.31

AN H= 2.31 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	1	0	0	0	1	1	3	2	4	12
CE.ADM	0	0	0	2	0	0	0	1	0	3
COLL.ADM	0	0	0	1	0	0	1	0	0	2
CAMP.ADM	0	0	0	0	0	0	0	0	2	2
UNIV.ADM	0	1	0	0	1	0	0	0	0	2
COL TOTL	1	1	0	3	2	1	4	3	6	21
AV. RANK	1.0	2.0	0.0	4.0	6.5	8.0	10.5	14.0	18.5	

(FREQUENCY OF RANKS)

UNCORRECTED H= 7.69 CORRECTION FACTOR=.96 H= 7.97

AN H= 7.97 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
CE.FAC	CE.ADM	5.08	3.934	1.291	MAY BE 0
CE.FAC	COLL.ADM	5.16	4.655	1.108	MAY BE 0
CE.FAC	CAMP.ADM	-6.08	4.655	-1.306	MAY BE 0
CE.FAC	UNIV.ADM	8.16	4.655	1.752	MAY BE 0
CE.ADM	COLL.ADM	0.08	5.563	0.014	MAY BE 0
CE.ADM	CAMP.ADM	-11.16	5.563	-2.006	MAY BE 0
CE.ADM	UNIV.ADM	3.08	5.563	0.553	MAY BE 0
COLL.ADM	CAMP.ADM	-11.25	6.094	-1.846	MAY BE 0
COLL.ADM	UNIV.ADM	3.00	6.094	0.492	MAY BE 0
CAMP.ADM	UNIV.ADM	14.25	6.094	2.338	MAY BE 0

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	0	1	0	2	1	0	2	2	1	9
EE.ADM	0	0	0	0	0	0	1	1	0	2
COLL.ADM	0	0	0	1	0	0	1	0	0	2
CAMP.ADM	0	0	0	0	0	0	0	0	2	2
UNIV.ADM	0	1	0	0	1	0	0	0	0	2
COL TOTL	0	2	0	3	2	0	4	3	3	17
AV. RANK	0.0	1.5	0.0	4.0	6.5	0.0	9.5	13.0	16.0	

(FREQUENCY OF RANKS)

UNCORRECTED H= 6.67 CORRECTION FACTOR=.97 H= 6.87

AN H= 6.87 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	0	0	2	0	0	3	0	1	1	7
MIE.ADM	0	0	0	0	0	0	1	0	2	3
COLL.ADM	0	0	0	1	0	0	1	0	0	2
CAMP.ADM	0	0	0	0	0	0	0	0	2	2
UNIV.ADM	0	1	0	0	1	0	0	0	0	2
COL TOTL	0	1	2	1	1	3	2	1	5	16
AV. RANK	0.0	1.0	2.5	4.0	5.0	7.0	9.5	11.0	14.0	

UNCORRECTED H= 8.18 CORRECTION FACTOR=.96 H= 8.51

AN H= 8.51 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
MIE.FAC	MIE.ADM	-5.21	3.221	-1.617	MAY BE 0
MIE.FAC	COLL.ADM	0.53	3.743	0.141	MAY BE 0
MIE.FAC	CAMP.ADM	-6.71	3.743	-1.792	MAY BE 0
MIE.FAC	UNIV.ADM	4.28	3.743	1.143	MAY BE 0
MIE.ADM	COLL.ADM	5.75	4.262	1.349	MAY BE 0
MIE.ADM	CAMP.ADM	-1.50	4.262	-0.351	MAY BE 0
MIE.ADM	UNIV.ADM	9.50	4.262	2.229	MAY BE 0
COLL.ADM	CAMP.ADM	-7.25	4.668	-1.553	MAY BE 0
COLL.ADM	UNIV.ADM	3.75	4.668	0.803	MAY BE 0
CAMP.ADM	UNIV.ADM	11.00	4.668	2.356	MAY BE 0

R5: AWARDS AND PRIZES

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	2	1	3	0	0	3	1	1	1	12
EE.FAC	1	1	2	0	2	0	2	1	0	9
MIE.FAC	0	1	1	1	2	1	1	0	0	7
COL TOTL	3	3	6	1	4	4	4	2	1	28
AV. RANK	2.0	5.0	9.5	13.0	15.5	19.5	23.5	26.5	28.0	

UNCORRECTED H= 0.00 CORRECTION FACTOR=.98 H= 0.00

AN H= 0.00 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE
(P) UNDER THE NULL HYPOTHESIS OF P > .99

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
CE.FAC	2	1	3	0	0	3	1	1	1	12
CE.ADM	0	1	1	0	1	0	0	0	0	3
COLL.ADM	1	0	0	0	0	1	0	0	0	2
CAMP.ADM	0	0	0	0	0	0	2	0	0	2
UNIV.ADM	0	0	0	0	0	0	1	1	0	2
COL TOTL	3	2	4	0	1	4	4	2	1	21
AV. RANK	2.0	4.5	7.5	0.0	10.0	12.5	16.5	19.5	21.0	

UNCORRECTED H= 5.99 CORRECTION FACTOR=.98 H= 6.13

AN H= 6.13 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
EE.FAC	1	1	2	0	2	0	2	1	0	9
EE.ADM	1	0	0	0	0	1	0	0	0	2
COLL.ADM	1	0	0	0	0	1	0	0	0	2
CAMP.ADM	0	0	0	0	0	0	2	0	0	2
UNIV.ADM	0	0	0	0	0	0	1	1	0	2
COL TOTL	3	1	2	0	2	2	5	2	0	17
AV. RANK	2.0	4.0	5.5	0.0	7.5	9.5	13.0	16.5	0.0	

UNCORRECTED H= 5.69 CORRECTION FACTOR=.97 H= 5.89

AN H= 5.89 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
MIE.FAC	0	1	1	1	2	1	1	0	0	7
MIE.ADM	1	2	0	0	0	0	0	0	0	3
COLL.ADM	1	0	0	0	0	1	0	0	0	2
CAMP.ADM	0	0	0	0	0	0	2	0	0	2
UNIV.ADM	0	0	0	0	0	0	1	1	0	2
COL TOTL	2	3	1	1	2	2	4	1	0	16
AV. RANK	1.5	4.0	6.0	7.0	8.5	10.5	13.5	16.0	0.0	

UNCORRECTED H= 9.98 CORRECTION FACTOR=.98 H= 10.24

AN H=10.24 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.05 > P > .02

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.58

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
MIE.FAC	MIE.ADM	5.11	3.243	1.575	MAY BE 0
MIE.FAC	COLL.ADM	2.28	3.769	0.604	MAY BE 0
MIE.FAC	CAMP.ADM	-5.21	3.769	-1.382	MAY BE 0
MIE.FAC	UNIV.ADM	-6.46	3.769	-1.713	MAY BE 0
MIE.ADM	COLL.ADM	-2.83	4.291	-0.659	MAY BE 0
MIE.ADM	CAMP.ADM	-10.33	4.291	-2.407	MAY BE 0
MIE.ADM	UNIV.ADM	-11.58	4.291	-2.698	IS < 0
COLL.ADM	CAMP.ADM	-7.50	4.700	-1.595	MAY BE 0
COLL.ADM	UNIV.ADM	-8.75	4.700	-1.861	MAY BE 0
CAMP.ADM	UNIV.ADM	-1.25	4.700	-0.265	MAY BE 0

R6: RESEARCH PROPOSALS FUNDED

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	2	0	1	3	1	2	3	0	12
EE.FAC	1	0	1	2	0	2	1	1	1	9
MIE.FAC	1	2	0	1	1	0	1	0	1	7
COL TOTL	2	4	1	4	4	3	4	4	2	28
AV. RANK	1.5	4.5	7.0	9.5	13.5	17.0	20.5	24.5	27.5	

UNCORRECTED H= 1.20 CORRECTION FACTOR=.98 H= 1.22

AN H= 1.22 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCF
WITH RESPECT TO MEANS OF 0.70 > P > .50

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	2	0	1	3	1	2	3	0	12
CE.ADM	0	1	0	0	1	1	0	0	0	3
COLL.ADM	0	0	0	0	0	0	0	2	0	2
CAMP.ADM	0	1	0	0	1	0	0	0	0	2
UNIV.ADM	0	1	0	0	0	1	0	0	0	2
COL TOTL	0	5	0	1	5	3	2	5	0	21
AV. RANK	0.0	3.0	0.0	6.0	9.0	13.0	15.5	19.0	0.0	

UNCORRECTED H= 5.78 CORRECTION FACTOR=.96 H= 6.04

AN H= 6.04 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	1	0	1	2	0	2	1	1	1	9
EE.ADM	0	0	0	1	1	0	0	0	0	2
COLL.ADM	0	0	0	0	0	0	0	2	0	2
CAMP.ADM	0	1	0	0	1	0	0	0	0	2
UNIV.ADM	0	1	0	0	0	1	0	0	0	2
COL TOTL	1	2	1	3	2	3	1	3	1	17
AV. RANK	1.0	2.5	4.0	6.0	8.5	11.0	13.0	15.0	17.0	

UNCORRECTED H= 4.46 CORRECTION FACTOR=.98 H= 4.54

AN H= 4.54 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	1	2	0	1	1	0	1	0	1	7
MIE.ADM	0	0	1	1	1	0	0	0	0	3
COLL.ADM	0	0	0	0	0	0	0	2	0	2
CAMP.ADM	0	1	0	0	1	0	0	0	0	2
UNIV.ADM	0	1	0	0	0	1	0	0	0	2
COL TOTL	1	4	1	2	3	1	1	2	1	16
AV. RANK	1.0	3.5	6.0	7.5	10.0	12.0	13.0	14.5	16.0	

UNCORRECTED H= 3.71 CORRECTION FACTOR=.98 H= 3.80

AN H= 3.80 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

R7: RESEARCH FUNDING

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	2	2	1	0	3	0	1	3	12
EE.FAC	1	0	3	1	1	1	0	0	2	9
MIE.FAC	0	1	2	1	1	0	1	1	0	7
COL TOTL	1	3	7	3	2	4	1	2	5	28
AV. RANK	1.0	3.0	8.0	13.0	15.5	18.5	21.0	22.5	26.0	

UNCORRECTED H= 0.66 CORRECTION FACTOR=.97 H= 0.68

AN H= 0.68 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.80 > P > .70

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	2	2	1	0	3	0	1	3	12
CE.ADM	0	0	0	0	1	0	0	2	0	3
COLL.ADM	0	0	0	0	0	0	0	0	2	2
CAMP.ADM	0	0	1	0	0	1	0	0	0	2
UNIV.ADM	1	0	0	0	0	0	0	0	1	2
COL TOTL	1	2	3	1	1	4	0	3	6	21
AV. RANK	1.0	2.5	5.0	7.0	8.0	10.5	0.0	14.0	18.5	

UNCORRECTED H= 3.81 CORRECTION FACTOR=.96 H= 3.94

AN H= 3.94 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	1	0	3	1	1	1	0	0	2	9
EE.ADM	0	0	0	1	0	0	0	0	1	2
COLL.ADM	0	0	0	0	0	0	0	0	2	2
CAMP.ADM	0	0	1	0	0	1	0	0	0	2
UNIV.ADM	1	0	0	0	0	0	0	0	1	2
COL TOTL	2	0	4	2	1	2	0	0	6	17
AV. RANK	1.5	0.0	4.5	7.5	9.0	10.5	0.0	0.0	14.5	

UNCORRECTED H= 3.38 CORRECTION FACTOR=.94 H= 3.59

AN H= 3.59 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	FREQUENCY OF RANKS 1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	0	1	2	1	1	0	1	1	0	7
MIE.ADM	0	0	0	1	1	0	0	1	0	3
COLL.ADM	0	0	0	0	0	0	0	0	2	2
CAMP.ADM	0	0	1	0	0	1	0	0	0	2
UNIV.ADM	1	0	0	0	0	0	0	0	1	2
COL TOTL	1	1	3	2	2	1	1	2	3	16
AV. RANK	1.0	2.0	4.0	6.5	8.5	10.0	11.0	12.5	15.0	

UNCORRECTED H= 4.77 CORRECTION FACTOR=.98 H= 4.85

AN H= 4.85 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

R8: HONORARY ELECTIONS

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	0	3	3	0	2	1	2	1	12
EE.FAC	0	1	1	0	3	1	0	2	1	9
MIE.FAC	0	0	0	0	1	1	0	3	2	7
COL TOTL	0	1	4	3	4	4	1	7	4	28
AV. RANK	0.0	1.0	3.5	7.0	10.5	14.5	17.0	21.0	26.5	

UNCORRECTED H= 4.48 CORRECTION FACTOR=.97 H= 4.60

AN H= 4.60 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.10 > P > .05

THE H OBTAINED IS SIGNIFICANT AT ALPHA=.10
PERFORM THE DUNN MULTIPLE COMPARISONS USING RANK SUM
ALPHA=.10 Z= 2.13

GROUPS COMPARED U	V	(1) CONTRAST	(2) SD OF CONTRAST	(3) (1)/(2)	(4) MEAN(U) - MEAN(V)
CE.FAC	EE.FAC	-1.05	3.577	-0.293	MAY BE 0
CE.FAC	MIE.FAC	-7.97	3.858	-2.065	MAY BE 0
EE.FAC	MIE.FAC	-6.92	4.088	-1.692	MAY BE 0

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	0	0	3	3	0	2	1	2	1	12
CE.ADM	0	0	0	0	0	0	3	0	0	3
COLL.ADM	0	1	0	0	0	0	1	0	0	2
CAMP.ADM	0	0	0	0	0	0	0	2	0	2
UNIV.ADM	0	0	0	0	0	0	0	1	1	2
COL TOTL	0	1	3	3	0	2	5	5	2	21
AV. RANK	0.0	1.0	3.0	6.0	0.0	8.5	12.0	17.0	20.5	

UNCORRECTED H= 7.12 CORRECTION FACTOR=.97 H= 7.36

AN H= 7.36 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.20 > P > .10

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
EE.FAC	Ø	1	1	Ø	3	1	Ø	2	1	9
EE.ADM	Ø	1	Ø	Ø	1	Ø	Ø	Ø	Ø	2
COLL.ADM	Ø	1	Ø	Ø	Ø	Ø	1	Ø	Ø	2
CAMP.ADM	Ø	Ø	Ø	Ø	Ø	Ø	Ø	2	Ø	2
UNIV.ADM	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1	1	2
COL TOTL	Ø	3	1	Ø	4	1	1	5	2	17
AV. RANK	Ø.Ø	2.Ø	4.Ø	Ø.Ø	6.5	9.Ø	1Ø.Ø	13.Ø	16.5	

(FREQUENCY OF RANKS)

UNCORRECTED H= 6.39 CORRECTION FACTOR=.96 H= 6.68

AN H= 6.68 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF Ø.2Ø > P > .1Ø

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
MIE.FAC	Ø	Ø	Ø	Ø	1	1	Ø	3	2	7
MIE.ADM	Ø	Ø	1	Ø	Ø	2	Ø	Ø	Ø	3
COLL.ADM	Ø	1	Ø	Ø	Ø	Ø	1	Ø	Ø	2
CAMP.ADM	Ø	Ø	Ø	Ø	Ø	Ø	Ø	2	Ø	2
UNIV.ADM	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1	1	2
COL TOTL	Ø	1	1	Ø	1	3	1	6	3	16
AV. RANK	Ø.Ø	1.Ø	2.Ø	Ø.Ø	3.Ø	5.Ø	7.Ø	1Ø.5	15.Ø	

(FREQUENCY OF RANKS)

UNCORRECTED H= 7.Ø4 CORRECTION FACTOR=.94 H= 7.52

AN H= 7.52 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF Ø.2Ø > P > .1Ø

R9: DEPARTMENT QUALITY RATING

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
CE.FAC	Ø	4	Ø	2	1	1	1	1	2	12
EE.FAC	Ø	2	Ø	1	Ø	1	4	Ø	1	9
MIE.FAC	1	2	1	1	1	Ø	Ø	Ø	1	7
COL TOTL	1	8	1	4	2	2	5	1	4	28
AV. RANK	1.Ø	5.5	1Ø.Ø	12.5	15.5	17.5	21.Ø	24.Ø	26.5	

(FREQUENCY OF RANKS)

UNCORRECTED H= 2.Ø6 CORRECTION FACTOR=.97 H= 2.14

AN H= 2.14 WITH DF= 2 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF Ø.5Ø > P > .3Ø

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
CE.FAC	0	4	0	2	1	1	1	1	2	12
CE.ADM	0	0	0	0	0	2	0	0	1	3
COLL.ADM	1	0	0	1	0	0	0	0	0	2
CAMP.ADM	0	0	1	0	0	1	0	0	0	2
UNIV.ADM	0	0	2	0	0	0	0	0	0	2
COL TOTL	1	4	3	3	1	4	1	1	3	21
AV. RANK	1.0	3.5	7.0	10.0	12.0	14.5	17.0	18.0	20.0	

UNCORRECTED H= 4.65 CORRECTION FACTOR=.98 H= 4.75

AN H= 4.75 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.50 > P > .30

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
EE.FAC	0	2	0	1	0	1	4	0	1	9
EE.ADM	1	0	1	0	0	0	0	0	0	2
COLL.ADM	1	0	0	1	0	0	0	0	0	2
CAMP.ADM	0	0	1	0	0	1	0	0	0	2
UNIV.ADM	0	0	2	0	0	0	0	0	0	2
COL TOTL	2	2	4	2	0	2	4	0	1	17
AV. RANK	1.5	3.5	6.5	9.5	0.0	11.5	14.5	0.0	17.0	

UNCORRECTED H= 5.52 CORRECTION FACTOR=.97 H= 5.69

AN H= 5.69 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.30 > P > .20

GROUPS COMPARED	1	2	3	4	5	6	7	8	9	ROW TOTL
	FREQUENCY OF RANKS									
MIE.FAC	1	2	1	1	1	0	0	0	1	7
MIE.ADM	0	1	1	0	0	1	0	0	0	3
COLL.ADM	1	0	0	1	0	0	0	0	0	2
CAMP.ADM	0	0	1	0	0	1	0	0	0	2
UNIV.ADM	0	0	2	0	0	0	0	0	0	2
COL TOTL	2	3	5	2	1	2	0	0	1	16
AV. RANK	1.5	4.0	8.0	11.5	13.0	14.5	0.0	0.0	16.0	

UNCORRECTED H= 1.07 CORRECTION FACTOR=.96 H= 1.12

AN H= 1.12 WITH DF= 4 HAS PROBABILITY OF OCCURRENCE (P)
UNDER THE NULL HYPOTHESIS OF NO GROUP DIFFERENCE
WITH RESPECT TO MEANS OF 0.90 > P > .80

Appendix C

PARAMETRIC ANALYSES OF VARIANCE

As noted in Chapter VI, the Chi-square large sample approximation had to be used in the Kruskal-Wallis test even though the number of individuals in the administrator groups was obviously small. Given this violation of the large sample assumption, it was considered desirable to test the stability of the results obtained. One possibility would be to make comparable parametric analysis of variance (ANOVA), with the full recognition that the measurement assumptions of ordinal data were violated.[1] The results of the parametric and nonparametric ANOVA are compared in this appendix. The overall picture of the comparison is one of widespread agreements. When decisions regarding significant differences were inconsistent at the 0.10 level, as in 7 out of 53 cases, the parametric ANOVA detected significant differences in 5 of the 7 cases. With these qualifications, it may be said that the results of the parametric and non-parametric ANOVA were largely consistent with each other, given the different kinds of violations of assumptions in each method.

TABLE C-1

A COMPARISON OF RESULTS OF PARAMETRIC AND NONPARAMETRIC ANALYSES OF VARIANCE (ANOVA)

Column A: Results of Parametric ANOVA
Column B: Results of Nonparametric ANOVA

	Comparison							
	I		II		III		IV	
Indicator	A	B	A	B	A	B	A	B
K-1			&&&	**		*	&&&	**
K-2	&	*	&&&	***	&	*	&&&	***
K-3	&&	*	&&	**	&&&	*	&	*
K-4	&	*			&	*	&	*
K-5			&	*		*	&&&	**
K-6	&	*	&&&	**	&&	*	&&	**
K-7			&&&	**	&	*	&&	*
K-8	&	*				*	&	*
R-1	&	*		*	&	*		
R-2					&	*		
R-3				*			&	*
R-4	&	*	&	**	&	*	&&	**
R-5			&	*	&	*	&&&	***
R-6			&	*	&	*	&	*
R-7			&	*	&	*	&	*
R-8	&	**	&	*	&	*	&&	*
R-9	&	*	&	*	&	*		

See notes for Table 9, with the following additions for parametric ANOVA:

P' = the probability of occurrence of the obtained test statistic F under the null hypothesis of no group difference with respect to the mean with the appropriate degrees of freedom.

Symbol	Value of P'
&&&	$P' \leq 0.05$
&&	$0.05 < P' \leq 0.10$
&	$0.10 < P' \leq 0.50$
[Blank]	$0.50 < P'$

Footnote to Appendix C

[1]Kim examined the ordinal and parametric strategies used in analyzing ordinal data and came to the conclusion that "the ordinal strategy is no better than the parametric strategy at meeting some of the basic requirements of multivariate analysis." Jae-On Kim, "Multivariate Analysis of Ordinal Variable," American Journal of Sociology 81 (September, 1975), p. 261.

The parametric ANOVA were made in the present study to verify the results of the nonparametric ANOVA. To the extent that the results from both types of analyses were compatible, one would have greater confidence that the violations of assumptions in either case did not distort the decisions regarding group mean differences.

VITA

James Lap-chi Chan was born on September 9, 1949, in China, where he received his elementary school education. Subsequently he attended secondary schools in Hong Kong, and was graduated with distinction from the International School of Bangkok, Thailand in June 1968. He then attended the University of Illinois at Urbana-Champaign, where he received his B.S. degree in accountancy with highest honors in June 1971, and a Master of Accounting Science degree in January 1973.

From 1969 to 1971, he was an Edmund J. James Scholar and was awarded an undergraduate tuition waiver scholarship by the University of Illinois. He was awarded a Delta Sigma Pi Scholarship Key and named to the Bronze Tablet (University Honors) upon receiving his baccalaureate degree.

James Chan is interested in higher education administration. He served on the Committee on Facilities, Enrollment and Programs (1972-73), and the Council on Program Evaluation (1973-74) of the University of Illinois at Urbana-Champaign. Since he entered the Graduate College in the summer of 1971, he worked as a research assistant in the Department of Accountancy and the Office of the Dean of the College of Commerce and Business Administration until the summer of 1974, when he was appointed to a similar position in the Dean's Office of the College of Engineering at the same institution.

He has been appointed as an Assistant Professor of Accounting in the School of Management at Syracuse University beginning with the spring semester of 1976.