

1-1-1992

## **At arm's length? : commercial research agendas, academic science, and the construction of organizational boundaries.**

John Michael Cavanaugh  
*University of Massachusetts Amherst*

Follow this and additional works at: [https://scholarworks.umass.edu/dissertations\\_1](https://scholarworks.umass.edu/dissertations_1)

---

### **Recommended Citation**

Cavanaugh, John Michael, "At arm's length? : commercial research agendas, academic science, and the construction of organizational boundaries." (1992). *Doctoral Dissertations 1896 - February 2014*. 6119. [https://scholarworks.umass.edu/dissertations\\_1/6119](https://scholarworks.umass.edu/dissertations_1/6119)

This Open Access Dissertation is brought to you for free and open access by ScholarWorks@UMass Amherst. It has been accepted for inclusion in Doctoral Dissertations 1896 - February 2014 by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact [scholarworks@library.umass.edu](mailto:scholarworks@library.umass.edu).

UMASS/AMHERST



312066012929511

AT ARM'S LENGTH?: COMMERCIAL RESEARCH AGENDAS,  
ACADEMIC SCIENCE, AND THE CONSTRUCTION OF  
ORGANIZATIONAL BOUNDARIES

A Dissertation Presented

by

JOHN MICHAEL CAVANAUGH

Submitted to the Graduate School of the  
University of Massachusetts in partial fulfillment  
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 1992

School of Management

© Copyright by John Michael Cavanaugh 1992  
All Rights Reserved

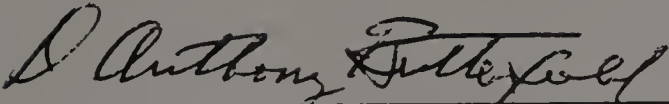
AT ARM'S LENGTH: COMMERCIAL RESEARCH AGENDAS,  
ACADEMIC SCIENCE, AND THE CONSTRUCTION OF  
ORGANIZATIONAL BOUNDARIES

A Dissertation Presented

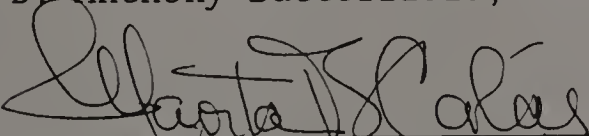
by

J. MICHAEL CAVANAUGH

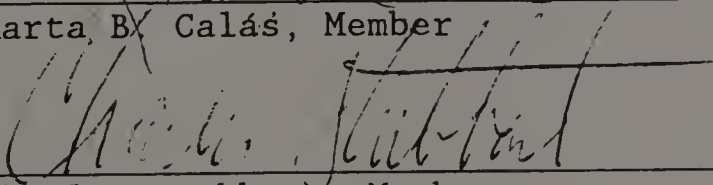
Approved as to style and content by:



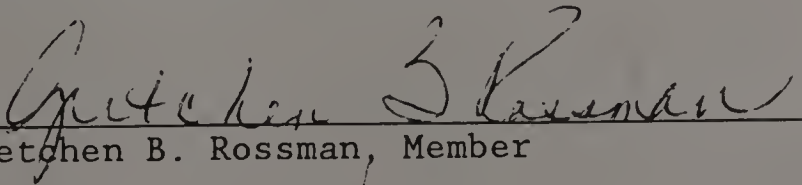
D. Anthony Butterfield, Chair



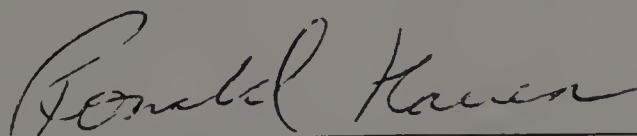
Marta B. Calás, Member



Charles Stubbart, Member



Gretchen B. Rossman, Member



Ronald Karren, Ph.D. Program Director  
School of Management

For Pat

ABSTRACT

AT ARM'S LENGTH?: COMMERCIAL RESEARCH AGENDAS,  
ACADEMIC SCIENCE, AND THE CONSTRUCTION OF  
ORGANIZATIONAL BOUNDARIES

May 1992

JOHN MICHAEL CAVANAUGH, B.A., ST. FRANCIS COLLEGE

B.S., BAYLOR COLLEGE OF MEDICINE

M.S., GEORGETOWN UNIVERSITY

M.B.A., RENSSELAER POLYTECHNIC INSTITUTE

Ph.D., UNIVERSITY OF MASSACHUSETTS

Directed by: Professor D. Anthony Butterfield

Concepts of organizational boundary have played a long and integral role configuring the intellectual landscape of organizational theory. By and large, organizational-environmental frontiers are simply assumed to be there. The interpenetrated condition of contemporary organizations and environments, however, bids us to question theorizing which treats organizations and environments as ontologically distinct entities.

In particular, a new generation of research alliances between a host of American research universities and multi-national corporations has provoked debate over the boundaries demarking university and industrial interests. Some (Traditionalists) fear that the separation between academic and commercial practices is breaking down, particularly as the commercial potential and shrinking developmental timeframes in some laboratory-driven fields place a premium on market-oriented research, entrepreneurship and exclusive claims to information ownership. Others (Instrumentalists) counter that the academy needs to



update its internal system of values and priorities if universities are to effectively meet the needs of a contemporary knowledge-based society.

Accordingly, this exploratory study attempts to address the substantivity of organizational boundary by examining how those who presumably construct frontiers - in this case select groups of university faculty - define the normative boundaries of their academic work. Using the oppositional modes characterizing the Traditionalist/Instrumentalist discourse as conceptual brick and mortar, faculty were invited to construct the social relationships of their professional work. Thirty-one (31) faculty members Q sorted 66 issue statements in a study designed to give numerical form to their normative boundaries, in order to test (1) the ontological status of organizational boundaries and (2) the claims of the Traditionalist-Instrumentalist antithesis.

The indeterminacy of borders empirically elaborated in this study opens the literature's core territorial assumptions to interpretation. If, in other words, the "thingness" (Weick, 1977) of borders can no longer be sustained unproblematically, how is the Archimedian point of the management science universe - the single-minded, factual "organization" - to be located? Without firm boundaries, "insides" and "outsides" are no longer knowable. The ambiguity surrounding "the university's" location prompts a reconsideration of interpretive grammar that promotes organizations as sovereign and unified "centre(s) of calculation and classification" (Clegg, 1990).



The first problem in understanding an organization or a social system, is its location and identification. How do we know that we are dealing with an organization? What are its boundaries? What behavior belongs to the organization, and what behavior lies outside of it?

Daniel Katz and Robert L. Kahn (1966)

However, this possibility they regard to be a methodological fiction because, in the face of a multiplicity of occupational world images, any conception of "society as an autonomous, self-enclosed system with clear-cut boundaries" is obtainable only by a form of verbal magic.

Joseph Bensman and Robert Lilienfeld (1991)

TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT . . . . .	v
LIST OF TABLES . . . . .	xi
LIST OF FIGURES . . . . .	xii
CHAPTER	
1. THE CHANGED CONTEXT OF ACADEMIC RESEARCH . . . . .	1
Introduction . . . . .	1
Background . . . . .	2
The Debate: The University - An Economic or Non-Economic Institution? . . . . .	6
2. THEORETICAL FRAMEWORK . . . . .	12
Introduction . . . . .	12
The Rational Prototype . . . . .	13
The Natural Systems Tradition . . . . .	15
Open Systems . . . . .	17
Discussion: Recasting Boundary . . . . .	18
Complexing Organizational Boundary . . . . .	19
Enacting Boundary . . . . .	21
Summary . . . . .	22
3. ENACTING AMERICAN RESEARCH UNIVERSITIES . . . . .	29
Introduction . . . . .	29
University/Industry Relations: An Interpretive History . . . . .	34
In the Beginning: At Arm's Length . . . . .	34
A New Federal/University Contract: The Boom Years 1942-1966 . . . . .	36
1973 to the Present: The New Consolidation . . . . .	40
Negotiating University Boundaries . . . . .	44
4. RESEARCH PROCEDURES: Q METHODOLOGY - OPERATIONALIZING SUBJECTIVITY . . . . .	54
Introduction . . . . .	54
Q Methodology . . . . .	55
Procedure . . . . .	56
Q and R . . . . .	58
Q Statements . . . . .	61

	<u>Page</u>
Q-Sample Pretest . . . . .	61
Factor Analysis . . . . .	63
Factor Interpretation . . . . .	64
P-Sample . . . . .	66
The Two Departments and Their Relations with Industry . . .	67
Faculty Demographics . . . . .	70
 5. RESEARCH RESULTS AND DISCUSSION OF FINDINGS . . . . .	 72
Introduction . . . . .	72
Interpretation . . . . .	76
Discussion of Complete (66) Card Distributions by Major Factors A & B . . . . .	 79
Discussion of Category 1 and Category 2 Statement Distributions by Faculty Cohorts . . . . .	 80
List of Positively Consensual Statements with Factor Scores . . . . .	 82
Discussion of Positively Consensual Statements . . . . .	83
List of Negatively Consensual Statements with Factor Scores . . . . .	 84
Discussion of Negatively Consensual Card Statements . . . .	85
Discussion of Meaningfully Differentiated Statements . . .	85
Listing of Category 2 Statements with Factor Scores . . . .	87
Discussion of Category 2 Statement Distribution . . . . .	87
Listing of Category 3 Statements with Factor Scores . . . .	89
Discussion of Category 3 Statement Distribution . . . . .	89
Listing of Category 4 Statements with Factor Scores . . . .	91
Discussion of Category 4 Statement Distribution . . . . .	92
Listing of Miscellaneous Statements with Factor Scores . .	94
Discussion of Miscellaneous Statement Distribution . . . .	95
Listing of Negatively Scored Statements . . . . .	96
Listing of Positively Scored Statements . . . . .	96
Discussion of Discriminating Statements for Factor A . . .	97
Listing of Positively Scored Statements . . . . .	98
Discussion of Discriminating Statements for Factor B . . .	100
Summary and Discussion of Factor Results . . . . .	102
Factor A Historians - Closet Traditionalists? . . . . .	102
Instrumentalists - "Eating Your Cake and ..."? . . . .	104
Discussion . . . . .	105
 6. CONCLUSIONS WITHOUT CONCLUSIONS . . . . .	 108
Implications . . . . .	108
Limitations . . . . .	116
Contributions . . . . .	117

	<u>Page</u>
APPENDICES	
A. SAMPLE SCORE SHEET FOR Q SORT . . . . .	120
B. POPULATION (66) OF Q STATEMENTS BY TOPIC CATEGORY . . . . .	122
C. RESULTS OF FORCED TWO-FACTOR ANALYSIS . . . . .	130
D. FACTOR DEMOGRAPHICS . . . . .	132
BIBLIOGRAPHY . . . . .	135

LIST OF TABLES

	<u>Page</u>
TABLE	
4.1 Examples of Statement Factor Scores Arrayed by Factor . . . . .	65
5.1 Factor Loadings and Subjects . . . . .	73
5.2 Complete Factor Loadings . . . . .	74
5.3 Distribution of Factor A Statements . . . . .	78
5.4 Distribution of Factor B Statements . . . . .	78
5.5 Distribution of Non-Economic (Category 1) - "Traditionalist" and Economic - "Instrumentalist" (Category 2) Statements in Factor A . . . . .	80
5.6 Distribution of Non-Economic (Category 1) - "Traditionalist" and Economic (Category 2) - "Instrumentalist" Statements in Factor B . . . . .	80
5.7 Distribution of positively consensual statements in Factors A and B (Factor A statements in parens) . . . . .	82
5.8 Distribution of Negatively Consensual Statements in Factors A and B . . . . .	84
5.9 Distribution of Statement Items with Score Differentials of 4 or More by Factor . . . . .	86
5.10 Distribution of Category 2 (the university as an economic entity) Statements by Factors (Historians in parens) . . . . .	87
5.11 Distribution of Category 3 (academic disinterestedness) Statements by Factor (Factor A historians in parens) . . . . .	88
5.12 Distribution of Category 4 (Intellectual Property) Statements by Factor (Factor A historians in parens) . . . . .	91
5.13 Distribution of Miscellaneous Statements by Factor (Factor A historians in parens) . . . . .	94
5.14 Distribution of Statements Most Sharply Discriminative (cells -5, -4, and +5, +4) for Factor A (Historians) . . . . .	96
5.15 Distribution of Statements Most Sharply Discriminative (cells -5, -4, and +5, +4) for Factor B (Polymer Scientists) . . . . .	98

LIST OF FIGURES

	<u>Page</u>
FIGURE	
2.1 The Concentric Design of Organizational Ontology . . . . .	24
2.2 Transaction Cost Analysis: Containing Uncertainty With Prototypic Form . . . . .	26
3.1 The Components of Discourse: A Conceptual Schema of the Traditionalist/Instrumentalist Literature . . . . .	52
4.1 Scale Values and Cards per Cell . . . . .	57
4.2 Sample Q Sort . . . . .	58
6.1 The Ins(ides) and Outs(ides) of Organizational Theory: A Topographical Schema . . . . .	111
6.2 The Ontological Profile of the Organizational Literature .	113



## CHAPTER 1

### THE CHANGED CONTEXT OF ACADEMIC RESEARCH

*Many factors have been involved in the academy's courtship of industry, but one factor seems overriding. For the first time in basic biomedical research, the university has something extremely valuable to sell.*

Culliton (1981)

#### Introduction

Concepts of organizational boundary have played a long and integral role configuring the intellectual landscape of organizational theory. By and large, organizational-environmental frontiers are simply assumed to be there. The interpenetrated condition of contemporary organizations and environments, however, bids us to question theorizing which treats organizations and environments as ontologically distinct entities (George and Campbell, 1990).

Accordingly, this exploratory study attempts to address the issue of the substantivity of organizational boundary by examining how those who presumably construct frontiers - in this case select groups of university faculty - define the normative boundaries of their academic work.<sup>1</sup> Using the oppositional modes characterizing what we have designated here as the Traditionalist/Instrumentalist discourse as conceptual brick and mortar, faculty were invited to construct their own cartographies regarding the social organization of their professional relationships. Our findings provide a mathematical visualization of empirical boundaries at work. These constitute the basis for some critical questions about the ontological status of organizational



boundaries and the fundamental organization/environment dualism that boundaries configure.

This document is divided into six chapters. Chapter 1 sets the stage with a brief review of the changing context of university/industry relations and the debate that has ensued over the alleged reconstruction of research universities along the lines of the large business enterprise. Chapter 2 offers a cartographic analysis of the organizational literature. The indicative boundaries or geometry of seminal theories of organization are used to construct a concentric model of organizational theory. In conformance with the interpretive approach adopted here, Chapter 3 grounds the current debate over the materiality of university boundaries in an interpretive history of university/industry relations. Chapter 4 explains the operation of Q Methodology and its significance to this study in preserving the opinion of our faculty sample. In Chapter 5, findings are organized and interpreted using an array of visual displays. The conceptual implications of these findings and interpretations are presented in the final chapter (6) along with suggestions for future work.

#### Background

University, industry and government relations turned another corner in the early 1970s. Universities increasingly looked to industry to fill the gap created by the overall stabilization of (and in some cases deep cuts in) federal research and development (R & D) funds imposed by the Nixon administration (NSB, 1982). For example, federal support in 1972 dollars for academic R & D grew at an annual rate of 12% between 1953 and 1960, 14% from 1960 to 1968, and 0% between 1968 and 1974 (Rosenzweig, 1982: 17). At the same time, both government and

industry enlisted the university to help unlock the riddle posed by America's purported "innovation gap" (Reich, 1989; Lyon, 1982). Given the national mandate to replace an aging industrial base with globally competitive laboratory-driven technologies, university research was reconstituted as a critical economic resource inextricably tied to national power (Kenny, 1988). With active government involvement, these priorities have inspired an array of novel contractual arrangements between select research universities and a handful of giant multinational corporations to commercialize the fruits of academic research.

The numbers reflect industry's expanding role. Although government continues to underwrite the bulk of basic campus research (not to mention 33% of all in-house industrial R & D in 1985 [Blits, 1985]) industry's absolute and relative importance continues to expand. For instance, industrial support of university research doubled in constant dollars from 1966 to 1978 (Stankiewicz, 1986). Indeed, industry's share of total academic R & D funding climbed from 3% in the late 1970s to roughly \$750 million or one-tenth (10%) of the federal research contribution in 1988 (Stankiewicz, 1986; Powers, et al., 1988; Fuchsberg, 1989).<sup>2</sup> In the three years between 1981 and 1984 industry support increased by 8.5% per year (NSB, 1982). In 1987-88 a milestone of sorts was achieved with 51% of all industry support going to public institutions (particularly Ph.D.-granting research schools), up from 13.8% of total industry donations in 1956-57 (McMillen, 1989). In 1987-88 corporations contributed 22.6% of all voluntary support for higher education - an 82% increase from 1982-83 (Chronicle of Higher Education Almanac, Sept. 6, 1989).

This trend has been attributed to several key environmental and institutional factors including: decisions by university officials to aggressively seek out business patronage to offset the disruptive impact of volatile federal funding cycles (Rosenzweig, 1982; NSF, 1982); the enactment of a range of statutes clearing the way for commercializing university research (Dickson, 1984; Reams, 1986; Kenny, 1988); the climate of crisis symbolized by America's yawning trade deficits, declining productivity, and the eclipse of long-standing modes of manufacturing (Dickson, 1984); the rise of new information-driven technologies and the spread of science-based industry (OECD, 1984); and, not least, the shrinking gap between university discovery, on the one hand, and product development, on the other (Kenny, 1988; Lynton, 1987).

A series of legislative enactments and juridical opinions provided a major impetus for the commercialization of academic research. In 1980, Congress passed the Stevenson-Wydler Technology Innovation Act (Public Law 96-480) opening the way for university-based industrial-technology centers (Nelkin, 1984). Shortly thereafter, the passage of the landmark Patent and Trademark Amendments of 1980 (Public Law 96-517) liberalized patent law by awarding universities the right to retain title to publicly funded research discoveries. Coverage under this act was subsequently broadened and additional licensing restrictions were removed in 1984 under Public Law 98-620. Even if wholly supported by public monies, henceforth, university research was to be treated as private property. Granted the right to sell "exclusive licenses on all discoveries made under a company's sponsorship," the university became a magnet for foreign and U.S. investment (Bourke, 1989, p. 495). The effects of this deregulatory legislation were felt almost immediately.

"University administrators surveyed by the GAO (Government Accounting Office) indicated that Public Law 96-517 had been important in stimulating business sponsorship of university research, which grew 74 percent, from \$277 million in 1980 to \$482 million in 1985" (Kenny, 1988, p. 23). Significantly, the courts have chosen to interpret this legislation to the letter, not hesitating to hand down heavy fines for patent infringements (Kenny, 1988).

Along other fronts, tax laws were amended in 1981 to augment industry/university information transfers. Specifically, the Economic Recovery Tax Act (Public Law 97-34) enabled corporations to earn tax credits for research and development through 1986. P.L. 97-34 was extended for an additional three years under the 1986 Tax Reform Act. Legislatures and enforcement agencies have also turned a blind eye toward the problematic anti-trust issues arising from collaborative industrial and academic research ventures (Dickson, 1984; Kenny, 1988; see the U.S. Department of Justice's Antitrust Guide Concerning Research Joint Ventures, 1980). Recently, the National Institutes of Health, the nation's principle source of funding for biomedical research, announced that it was abandoning proposed conflict-of-interest guidelines (Gladwell, 1989).

This deregulatory thrust is not predicted to change course anytime soon. For one, the university's fiscal problems continue to mount in the face of declining state budgets and unfavorable demographic trends (a shrinking middle class and student-age cohort [Footlick, 1990]). By the same token, as American managers continue to borrow extravagant sums of money to retool factories or consolidate corporate empires, proportionately less capital is available for in-house research activity



(Markoff, 1990). The overriding financial rationale, in other words, remains intact. Hat in hand, universities add corporate patrons, while campus research offers industry the most expedient means for socializing risky research costs (Dickson, 1984).

The next section and following chapter (2) are meant to orient the reader to the characteristic perspectives of organizational boundary rendered in the Traditionalist, Instrumentalist, and Management literatures. These discussions supply the basic conceptual material for the comparative analysis of boundary presented in Chapters 4 and 5.

#### The Debate: The University - An Economic or Non-Economic Institution?

The past two decades have witnessed the advent of a new commercial compact between big business and the cream of American research universities. Increasingly, traditional philanthropic arrangements are being replaced by a preference for multi-year business partnerships and consortia often involving tens of millions of dollars. For the host of reasons specified earlier, university administrators and faculty find themselves under mounting pressure to commodify the fruits of research (Schaffer, 1980). The reputed emphasis on the entrepreneurization of the research process along with the marketization and privatization of research discovery has rekindled debate over the purpose and conduct of the university's intellectual culture.

Proponents for the "greater instrumentalism" of university research agendas and processes, for example, view research institutions as an underutilized national resource. Lynton and Elman (1987) are representative when they write that,

The existing, narrowly defined mold into which almost all universities have tried to cast themselves is not adequate to the expanding needs of our contemporary, knowledge-based

society. A large number of institutions are failing to realize their full potential because their internal system of values, priorities, and aspirations primarily emphasizes and rewards traditional modes of teaching for which the clientele is shrinking and basic research for which most of these institutions cannot receive adequate support (12).

Historical and logical necessity, it is argued, have created an imperative need to do for industry what the land-grant system accomplished for American agriculture.<sup>3</sup> New commercial breakthroughs, particularly in fast-breaking sciences like microelectronics and biotechnology, have obscured the line separating basic and developmental research activity. Ready or not, the ascendancy of science-driven technologies has ushered in a new interdisciplinary era necessitating a pragmatic reworking of industry/university boundaries.

Perhaps most importantly, the reputed reduction in the time required to develop new product applications in some fields has involved capital in virtually every phase of the university's discovery process. Dorothy Nelkin (1984) observes that,

In the past, commercial interests looked primarily to the goods and services produced through applied research; today, more fundamental knowledge is also recognized as having intrinsic value (2).

These developments overturn the popular idea of the university campus as a world apart. In sum, the "Instrumental" school avows, the vestigial cultural remnants of the 19th Century university must not be allowed to cramp the contemporary campus's (and the nation's) march toward modernization. Times have changed. Economic and military reconstruction sanctions the invention of more fluid institutional arrangements between industry, the university and the state to market the technology emerging from university laboratory discovery.

But a handful of less sanguine observers insist on examining the fine print. Suspecting a variant of Gresham's Law at work, they foresee the day when market-oriented behavior drives out the academy's collective operating norms. That is, the "Traditionalist" fears that as more academics adopt an entrepreneurial model of success, the deepening business/university interface that results will produce unintended and undesirable institutional consequences for the university and society at large (Noble & Pfund, 1980; Schaffer, 1980; Nelkin, 1984; Dickson, 1984; Rule, 1988; Werth, 1988).<sup>4</sup>

These concerns appear to derive from the assumption that the university and industry are each grounded in two essentially antithetical hierarchies of values: one (industry) based on a market exchange ethic where competition, private ownership and secrecy are the norm; the other (the university) on a property-less ethos where information (and the research and teaching function) is validated through determinations of social utility and the act of sharing (Gouldner, 1970; Price, 1986). Are policies intended to facilitate business and university collaboration, Traditionalists ask, in fact undermining the very existence of the university as a cooperative institution of liberal learning? These contradictory tendencies, they feel, need to be acknowledged and openly explored.

In sum, that the Traditionalist/Instrumentalist discourse exists suggests that established norms and patterns of work peculiar to the academic community in the United States have undergone substantive modification as universities have moved from an adjunct role as providers of scientific knowledge and personnel to the intersection of national economic development (Smith, 1974; Etzkowitz, 1989). The



upshot appears to be that the traditional divisions of labor differentiating the ethos of science and commerce, although never airtight, are today more obscured than ever before. The entrepreneurial inclinations of a growing number of leading academic scientists and university administrators make it increasingly difficult to obtain an accurate fix on where the university begins and industry ends. Business and government have become so deeply entrenched in some specialized areas of academic research that conventional definitions of organizational integrity based on precise delineations between "inside" and "outside" (and public and private) no longer seem to apply. All of this has culminated in a new awareness of boundary.

The controversy surrounding the University of Utah's cold-fusion experiments in the Spring of 1989 may serve to illustrate the point (McDonald, 1989; Blakeslee, 1989; Fuchsberg, 1989). The question asked by many scientists at the time was, did the management of the Pons-Fleischmann cold-fusion experiment represent a normative aberration or a symptom of larger institutional changes? On one level - that of craft - the issue was one of methodological competence. Did the research adhere to the established pragmatics of chemistry? Was, for example, the heavy water used to bathe the experiment evenly mixed? Were instruments calibrated correctly? On another level - the institutional - the foot-dragging release of vital experimental details frustrated the peer review process thus inviting widespread doubts (even ridicule) over the integrity of the scientists themselves (McDonald, 1989; Raymond, 1989; Noble, 1989; Browne, 1989). Apparently eager to establish a claim for intellectual priority and ownership, but at the same time keenly aware of the lucrative prospects for commercializing the results of their

work, did Drs. Pons and Fleischmann (egged on by university officials) behave more like scientists or businessmen?

The same kind of question is being asked about elite research universities as a class (Noble & Pfund, 1980; Nelkin, 1984; Dickson, 1984; Krinsky, 1987). What "business" are universities in? The powerful mutual attraction drawing university officials, leading scientists, and representatives of industry together, and the tacit redrawing of institutional borders that this allegedly entails, not only strains the integrity of organizational frontiers but the literature's foundational analytic categories as well (Etzkowitz, 1989).<sup>5</sup> In other words, the documented intimacy of universities and industry presents a special opportunity to reevaluate the adequacy of the unquestioned ontological status of organizational boundary, organizations, and environments shaping the literature's intellectual landscape.

#### Endnotes

1. "Substantivity" is Stewart Clegg's (1990) term. Clegg uses it to describe realist conceptions of organization bounded by fixed, material frontiers. Likewise, substantivity is used here to denote objectively discernible "thingness."
2. These figures actually understate industry's role because its support flows through a variety of direct and indirect channels, i.e., grants, private donations, foundations, hiring faculty, etc. (Zinberg, 1985), clearing the way for commercializing university research.
3. "The extension of public support for many sciences in the nineteenth century was premised upon their capacity to reduce uncertainty in key areas, such as agriculture" (Whitley, 1984: 140).
4. For example, after signing a ten-year, \$23 million pact with the Monsanto Corporation in 1974, Harvard "...discarded its traditional patent policy that 'no patents primarily concerned with therapeutics or public health may be taken out...except for dedication to the public'" (Reams, 1986: 105). In addition, "During the almost two-year period of negotiations between the

parties, the standard practice of peer review through faculty committees and public comment was avoided" (Reams, 1986: 105). Such flexibility is not unusual in the current climate of university/industry relations (see Dickson, 1984; Reams, 1986).

5. Henry Etzkowitz (1989) writes that incentives for change arise from two sources. "Shifts in federal funding patterns for academic research and federal policy changes regarding the ownership of intellectual property define the external context for these changes. The internal context is found in administrative and faculty reactions to these changes and to entrepreneurial activities at similar institutions" (15). For more historical detail, consult Chapter 3.

## CHAPTER 2

### THEORETICAL FRAMEWORK

*In the absence of distinguishable boundaries, there can be no organizations as we understand the term.*

Scott, 1987

#### Introduction

The ambiguity produced by the simultaneous forward integration of university science into the marketplace and deep backward integration of capital into the academic discovery process poses a dilemma for any theoretical system that treats organizations and environments as distinct entities, because it confounds the objective ontological status of organizational boundaries. In large part the materiality of organizational boundary underwriting the organization/environment duality parallels the theoretical metamorphosis of organizational constructs in the literature. That is, hand in hand with more contingent imagery of "organization," concepts of boundary have evolved from fixed concrete entities to something more provisional and processual. Still, however boundary is conceptualized or problematized, its critical bracketing function of differentiating organizations from environments continues to unify the literature.

A theoretical emphasis on boundary, then, makes it possible to analyze the literature's major contributors and schools according to the lines peculiar to each. Indeed, as this chapter will attempt to show, the degree of "facticity" that various theorists inject into "organizational boundaries" reveals much about the evolution of organizational theory's ontological presuppositions concerning



institutional order and change (Hall, 1981). For convenience, the essay below adheres to Scott's (1987) paradigmatic classification of the theoretical literature into rationalistic, natural, and open systems.

### The Rational Prototype

Thick, bold lines drawn at military angles are the hallmark of goal-driven, rationalistic models of organization (Gulick & Urwick, 1937; Mooney & Riley, 1939; Fayol, 1949; Frederick Taylor, 1911; Max Weber, 1946). The expeditious achievement of managerial objectives (functional rationality) dictated that structural boundaries be made mathematically explicit and visible (Scott, 1987). Fixed boundaries in the guise of formalized roles, procedures and rules underwrote management's master plan, insured workplace compliance, and isolated the organization's core rationality from potentially destabilizing extra-organizational forces.

Certainty was encapsulated within a jurisdictional vocabulary - functionalization, specialization, standardization, and specification - delineating a highly formalized set of interdependent functional relationships. The early Classical Management theorists (Taylor, 1911; Gulick & Urwick, 1937; Mooney & Riley, 1939; Fayol, 1949), for example, constructed their clockwork model of organization around an unquestioned adherence to designated chains and spans of control. Frederick Taylor's (1911) "scientific" formula to standardize work specified the longitude and latitude of formal organization - the division and coordination of labor. And Weber's (1946) ideal of rational-legal authority entailed a juridical hierarchy of roles. Organizations were first and last "technical instruments" (Selznick, 1957), where the worker ["an irritant

that must be controlled"] (Astley & Van de Ven, 1983)] was "fitted" to a mechanical order of technical requirements. Driven by "a (maximizing and utilitarian) logic of cost and efficiency" organizational administration constituted an exercise in social engineering (Roethlisberger & Dickson, 1939).

Boundaries, however, need not always be so sharply drawn. It occurred to some that efficiency might be enhanced if structural boundaries were made less conspicuous. Control, that is, could be rendered less obtrusive and ultimately less conflictual, if the premises of decisions were encoded in organizational structure itself (Simon, 1947; Perrow, 1979; Edwards, 1979). In this way, individual rationality is "bounded" within a skein of means-ends chains of management algorithms. Self-interest, idiosyncrasy and novelty (i.e., irrationalities) are bracketed by the attention-directing structure embedded in organizational routine, language and official channels of communication (Simon, 1947). In short, prescribed behavior is subtly packaged in a cybernetic pyramid of Skinnerian boxes. The foreman was made superfluous after organizational control came to mean applying the right structure. In deciding on the limits of self-determination, management's principal task was to get its lines right.

In sum, the conceptual closure (Thompson, 1967) assumed by closed rational models of organization takes the objective integrity of boundaries for granted. Boundaries shelter an aseptic, frictionless space - a management laboratory where, except for a limited set of variables, all others are controlled for. The organization as such exists (encapsulated) on its (management's) own terms, an independent variable. As the formal embodiment of management's expectations the

closed rational paradigm has come to represent the literature's unrequited anatomical ideal, one strongly imprinting the ontological contours of subsequent work.

Interestingly, closed systems have not only served as the literature's analytical prototype, but the touchstone of conceptual tensions as well. That is, closed systems in any pure sense were destined to be short-lived, because the extraordinary levels of formalization prescribed simply required too many lines. The circumscribed autonomy prescribed by such models virtually begged for modification if efficiencies were to be achieved. In the final analysis, systems specifically designed to drive out efficiency-sapping contradictions like conflict and low morale succeeded in fostering the opposite, sending theorists and managers back to the proverbial drawing board.

#### The Natural Systems Tradition

Objectified notions of organizational boundary softened somewhat after Roethlisberger and Dickson (1939) stumbled across the factory *Gemeinschaft*. Management to be sure still choreographed the formal organization. However, the discovery of work quotas, informal status hierarchies and leadership patterns indicated that overall organizational design could no longer be realistically claimed an exclusive management prerogative. Alienated workers proved adept at drawing lines too (Burrell & Morgan, 1979). Management, it appeared, had lost the last word in defining task borders after workers were found to be busy interpreting them.



The interest in informal and small group processes spawned by the Hawthorne studies (Maier, 1952; Katz et al., 1950; Homans, 1950; Whyte, 1951; Sayles, 1958; Roy, 1952; Seashore, 1954) suggested that management did not impose boundaries so much as initiate them (Barnard, 1938). In other words, the concept of "social man" flirted with the radical possibility that structural boundaries were negotiable and corrigible and that rationality was only one goal among many.

Concerned by the shopfloor backlash occasionally ignited by more overt and coercive forms of control, human relations pioneers campaigned to eliminate boundaries (and organizational politics) altogether (Barnard, 1938; Mayo, 1945). The costly apartheid dividing labor and management conflicted with the institution of a classless "condition of (moral) communion" (Barnard, 1938). Perhaps if the right incentives were implemented cultural authority might replace coercive authority. Boundaries might then be interiorized. Even distinctions between the informal and formal organization might be erased, "formal organizations arise out of and are necessary to informal organization; but when formal organizations come into operation, they create and require informal organizations" (Barnard, 1968: 120).<sup>1</sup>

Excepting Barnard, then, and the work of Selznick (1948) and Parsons (1960), the Natural Model remained essentially contextless and inward-looking.<sup>2</sup> However, the fact that organizational models were now inhabited - no longer lifeless - impacted thinking about boundary. Specifically, the presence of the informal organization admitted the possibility for tension between autonomy and imposed structure thereby creating theoretical space for interpretation, negotiation and change.

## Open Systems

The installation of the environment as the source of theoretical order signified the end of the literature's Ptolemaic legacy. No longer a self-sufficient, self-constituted entity, the organization is, in effect, decentered, reduced to a constituent part of a larger and more powerful constellation of organizations and constituencies (Katz & Kahn, 1966). Within this new Copernican schema the environment sets varied adaptive tasks leaving managers little choice but to respond in some appropriate manner if the organization is to survive. Moreover, recognition of environmental whimsy introduces new requirements for structural flexibility complicating management's line-drawing functions. The combined "morphogenetic" needs of the organization and the environment (Buckley, 1967) transforms organizational boundaries, both internal and external, into improvisations. As concepts of boundary shed their static qualities, boundary maintenance develops into a management priority. The quixotic chase after the one best way to organize is finally laid to rest (Burns & Stalker, 1961).

If environment acts and organizations react, then, organization design (boundary-setting) is never complete (Lawrence & Lorsch, 1967). "Social organizations, more variable and loosely coupled than biological systems, can and do fundamentally change their structural characteristics over time" (Scott, 1987: 83). At times, the environment may wreak havoc with organizational topography (Hannan & Freeman, 1977; Aldrich & Pfeffer, 1976), but management, particularly in oligopolistic sectors of the economy, is not without options. For example, vulnerability can be reduced by appropriating environmental uncertainty (Williamson, 1975), or with a modicum of self-insight, enacting a more

manageable environment (Weick, 1979; Smircich & Stubbart, 1985). Or, managers can engage in proactive policies by striking bargains with their respective environments. For instance, network models (Blau & Scott, 1962; Emery & Trist, 1965), resource dependency models (Pfeffer & Salancik, 1978) and a host of buffering and scanning strategies (Thompson, 1967; Galbraith, 1977) enable managers to effect an organizational/environmental accommodation.

No doubt, the notions of environmental contingency and change made organizational design more difficult. Indeed, the new levels of uncertainty introduced by environmentally-induced contingencies underscored the need for concise boundaries. If the organization was to remain the central unit of analysis and seat of control, then its core rationality had to be insulated from environmental contingency and surprise. The definition of organizational boundary may have been revamped with the advent of the Open System perspective, but the need for boundary had not.

#### Discussion: Recasting Boundary

One's first impulse in the wake of this discussion is to conclude that concepts of organizational boundary have mellowed - turned more synthetic with age, particularly as theoretical models have grown more sociological in content and scope. However, closer inspection suggests that boundary-setting has not lost any of its original appeal. Granted, contemporary concepts of boundaries resemble semi-permeable membranes. But the literature's familiar ontological landmarks have endured because its basic text remains secure - the will to control (Edwards, 1979; Perrow; 1979; Scott, 1987; Ferguson, 1984). As a consequence, many

time-honored conceptual dichotomies have not been modified in any substantive way at all - particularly the pivotal binary polarity segregating insides (organizations) and outsides (environments).

Without question, the relative complexities of the Natural and Open paradigms have interjected more contingency and uncertainty into the literature. Nonetheless, the desire for a predictable order operates undiminished. Implicitly, both the Natural and Open metaphors covet the metric sovereignty of the Rational prototype. The specialized structure of authority embodied in each of these germinal paradigms still turns on the coordinating oversight of a systems-designer. Each in its way privileges supervision. That is, each centers management to speak to things "as they are" (de Man, 1979). The control over the construction of boundary (and denomination) underwrites the literature's longstanding policy of containment - everything in its proper place (Zeitz, 1980).

#### Complexing Organizational Boundary

The Rational, Natural and Open paradigms not only share common boundaries, but all take the integrity of organizational/environmental frontiers for granted. For each of these structuralist templates precise boundaries are essential for delineating domains of function and control vital to the generic problem of order embodied in functionalist ontology (Burrell and Morgan, 1979). Perhaps Open Systems theory's fascination with organizational design constituted the high water mark for positioning organizational boundaries (Katz & Kahn, 1961; Thompson, 1967).



The subsequent advent of Contingency Theory in the late 1960s and early 1970s, however, made locating organizational boundaries a more daunting analytical task. For one, Contingency theory's preeminent interest in documenting proper "fits" between context and organizational design required a new level of organizational adaptability (Gresov, 1989). Second, the literature's emphasis on environmental uncertainty (and corollary departure from norms of rationality) tended to obscure analytical lines even more (March & Simon, 1958; Cohen, March & Olsen, 1977; Weick, 1976). Third, the sophistication of Contingency models - the addition of elusive concepts such as technology, power, and lateral linkages, for example - only exacerbated definitional and operational problems (Woodward, 1965; Lawrence & Lorsch, 1967; Thompson, 1967; Perrow, 1968; Hage & Aiken, 1969; Pugh et al., 1969; Galbraith, 1973; Dachler & Wilpert, 1978; Pfeffer, 1981), since situating analytic boundaries is virtually impossible if conceptual elements cannot be elucidated with adequate precision (Venkatraman & Prescott, 1990).

Last, but not least, recognition of isomorphic contexts and interdependencies problematized the criteria used to differentiate "insides" from "outsides" (Meyer & Rowan, 1977; Zucker, 1983; Dimaggio & Powell, 1983; Astley & Van de Ven, 1983). Scott (1987) neatly captures the ontological problematic that these contingencies pose, "The nested nature of organizational environments as well as the penetration of organizations by their environments raises serious problems for investigators who are trying to decide where to draw boundaries for analytic purposes" (139).

Each of these conditions places the identification and measurement of boundary in doubt. In their own way Contingency theorists

problematize the ontological status of boundary in their determined efforts to pin it down. Nevertheless, no one steps forward to grapple with the paradigmatic contradictions that these complex models present. Although conceptual boundary has become as porous as the Mexican-American border, by and large the organizational literature continues to treat organizational boundary as a concrete "thing." On occasion, the environment compels tactical realignments. But in the end, boundaries are known - something you can put your finger on. Despite the interpenetration of organizations and environments emphasized by Contingency theorists, it was still important to set organizations and environments apart.

#### Enacting Boundary

The development of a social constructionist track embodying less deterministic notions of social constraints and an expanding conception of human agency has brought to light the intersubjective side of boundary-setting (Geertz, 1973; Bittner, 1965; Berger & Luckman, 1967; Smircich, 1983). With this last "interpretive turn" (Geertz, 1983) theories of organization as closed representational objects were forced to compete with concepts of organizations as open texts that both generate meaning and subvert it (Brown, 1978; Gray, Bougon & Donnellon, 1985; Johnson, 1990).

Thus, uncomfortable with essentialist models of organization, a handful of scholars have come to view boundary as the intersection of organizational tensions (Weick, 1977; Benson, 1977; Brown, 1978; Giddens, 1979; Riley, 1983) - the locus of encounter. As boundaries are redefined as crucibles of reciprocative action analytic focus has

gradually turned to how we draw our lines (Van Maanen, 1979; Burrell & Morgan, 1979; Weick, 1979; Astley & Van de Ven, 1983; Fiol, 1989; Milliken, 1990). Yet, despite the fact that concepts involving cohesive theoretical boundaries are virtually inverted in a subjectivist literature promoting the precarious status of organizational boundaries, the reality of the foundational organization/environment construct that organizational boundary undergirds is never in question.

### Summary

One way to grasp the literature's seemingly abiding interest in organizational boundary is to consider the differing paradigms of organization which boundaries serve to perpetuate. To this end, the subjectivist perspective begins with a major conceptual advantage because it assumes that boundaries are pliant intersubjective conveniences demarking different conceptual terrains (Ranson, Hinings, & Greenwood, 1980). Thus, boundaries are by definition open to question. An interpretive epistemology, in other words, authorizes the proposal that whereas the evolving consistency of theoretical boundaries may reflect the literature's various concessions to changing social circumstances; nonetheless, boundary making continues to emanate from an unvarying (classical core) cognition of what organization is - a cognition grounded in a particular historical time and place (Geertz, 1973a, 1973b).

This enduring classical legacy is a product of an era when theorists and practitioners were free to draw their lines virtually at will. For practical and theoretical purposes, the external environment did not exist because countervailing interests were, often as not, too



weak to gain a vote in the boundary-setting processes monopolized by management elites (Edwards, 1979). The trademark castle-thick walls preferred by Classical theorists, therefore, encompassed an idealized concept of organization as the embodiment of a unitary, rational core. However, as the "needs" (read relative power) of the environment (read other constituencies, e.g., labor, consumers, government, etc.) expanded, managements were compelled to acknowledge other stakeholders (this recognition is implicitly reflected in Open Systems and later Contingency theory). Yet, deep at heart, the literature remained wedded to the central planning and control inherent in the Classical school's hierarchical, dedicated, mass-production industrial paradigm (Piore & Sabel, 1984; Graham, 1991).

As yet more environmental exigencies spilled over fixed notions of organizational frontiers, theorists reacted by deploying two ontologies of boundary in a rearguard effort to preserve this core industrial identity. In effect, the core was encircled by two lines of defense. The first, outer, membrane-like ring consisted of an intersubjective ontology where environmental and organizational "fits" were enacted. This interactive rim was backed up by a second inner, objective frontier - a theoretical Maginot Line sheltering the literature's wellhead of coherent meaning. Theorizing within this "hermetically sealed tradition" (George & Campbell, 1990), Thompson (1967), for example, logically emphasizes the importance of buffering technical cores and regulating boundary spanning action. Such design strategies isolated the classical paradigm from environmentally induced uncertainty by withdrawing its hard core inward to a cool (dispassionate), incontestable, non-dialectical, reified "interior" (see Figure 2.1).

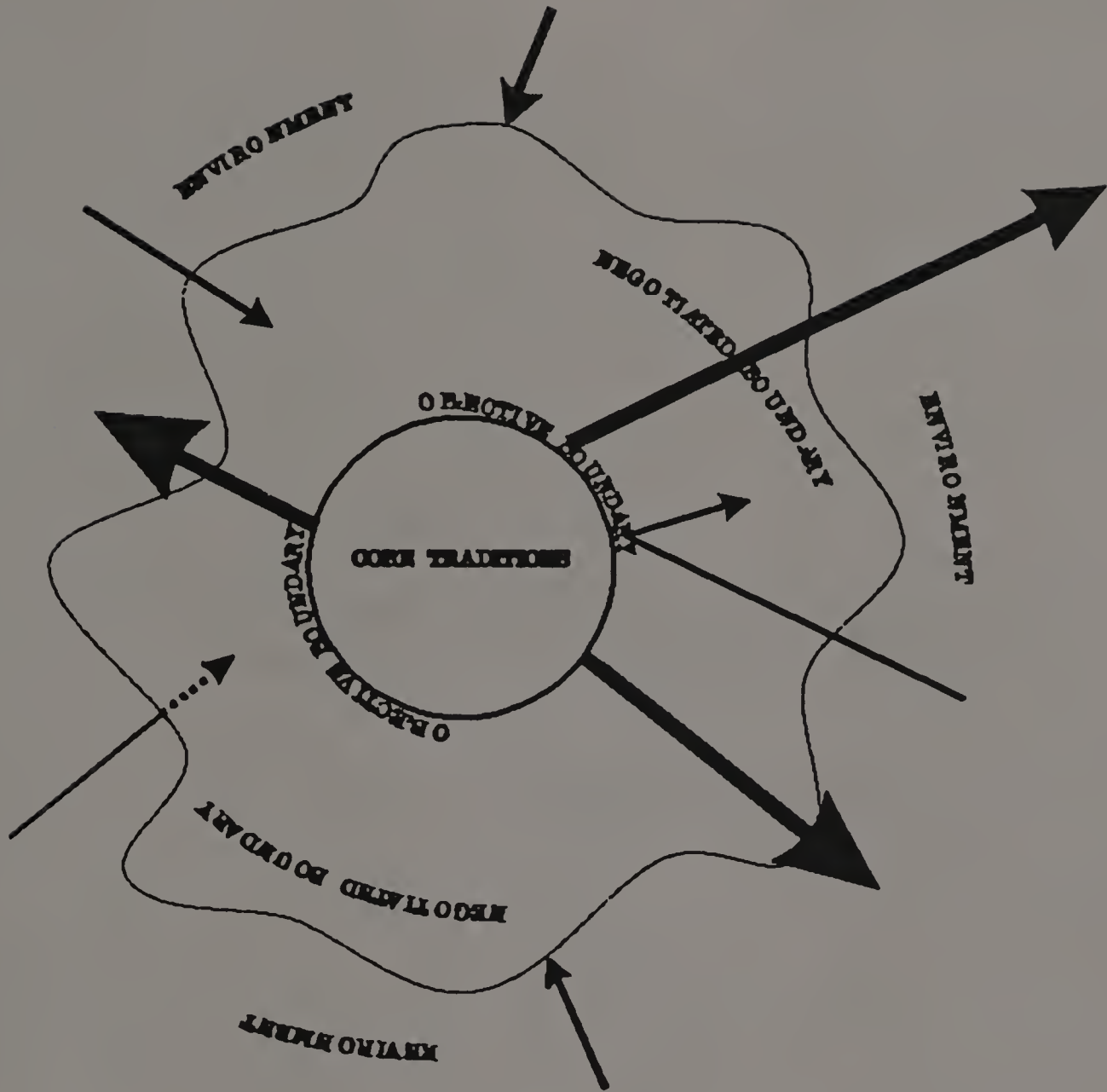


Figure 2.1. The Concentric Design of Organizational Ontology

This concept of concentric ontology also enables a reinterpretation of more contemporary theorizing. Oliver Williamson's (1975; 1981) influential analyses of transactions costs, for example, can now be seen to represent a form of conceptual retrenchment or irredentism wherein a problematic environment is ultimately subordinated to the static imperatives of the (core) centralized ideal. With boundary made permanent once again and the variability of the marketplace (the environment) thereby normalized, Williamson is able to restore the classical ideal to its original form. The theoretical core and the organization in its entirety are made one again (Figure 2.2).

This suggests that the literature's boundaries preserve a way of thinking dedicated to the maintenance of a "fixed order" (Cox, 1981) of organizing. Boundaries, in other words, operate to constrain and often foreclose debate on the prospects and nature of change ignited by the global social and economic forces now underway (Attali, 1991). Thus, core theory remains blind to or incapable of explaining the complex interpenetrations of institutions and ideas arising from an environment driven by the "internationalization of economic authority" (George & Campbell, 1990), sweeping deregulation of traditional institutional structures (Graff, 1979; Dickson, 1984; Lyotard, 1984), and the dissemination of flexible manufacturing technologies (Nemetz & Fry, 1988; Huber, 1990).

At this point it becomes necessary to ask if the literature has unwittingly entered a Kuhnian (1962) watershed where prevailing functionalist concepts of organizing are simply too neat - too discrete - to engage the present swirl of interdependent events? Failure to "interrogate present knowledge", Der Derian (1989) warns in another

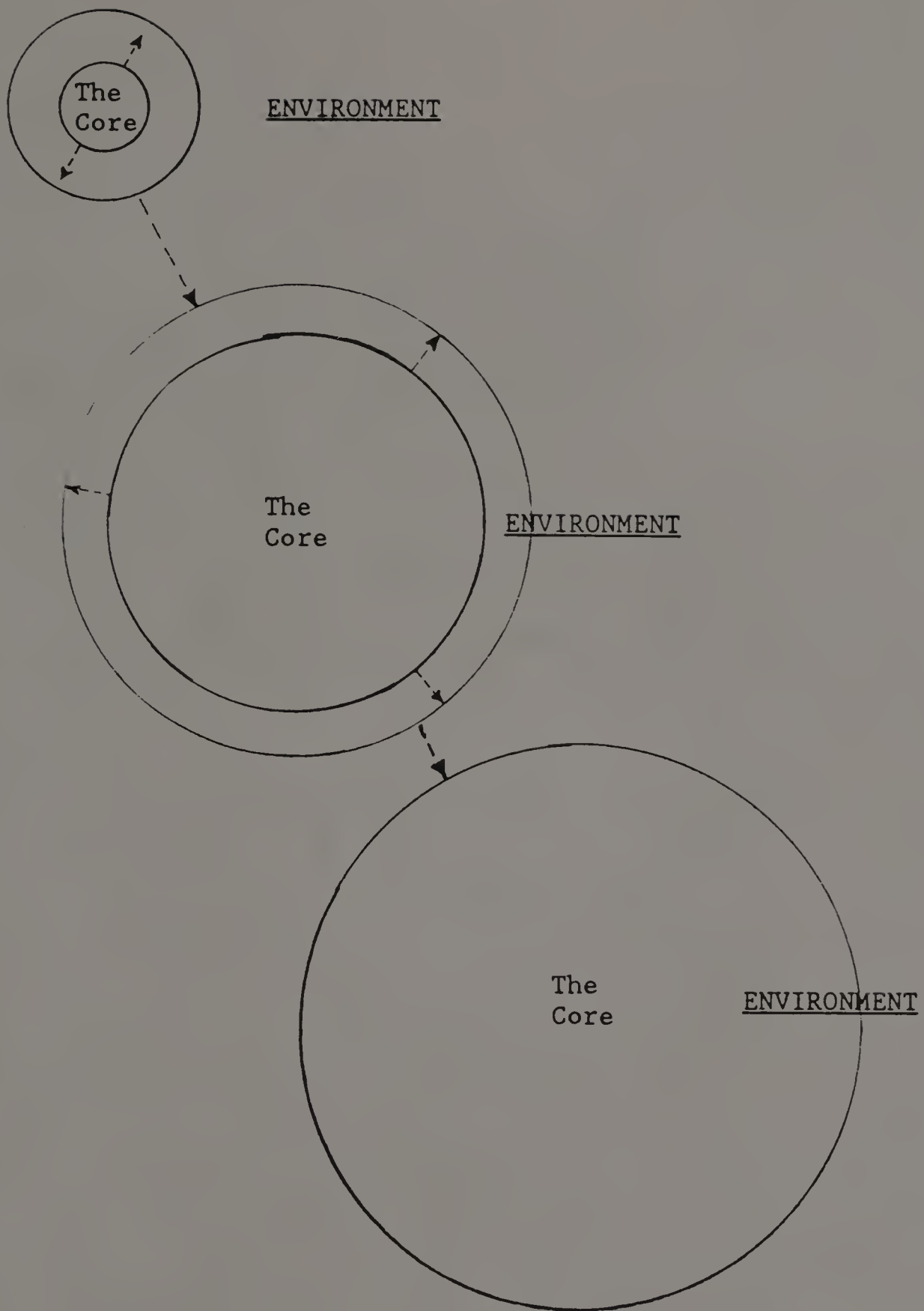


Figure 2.2. Transaction Cost Analysis: Containing Uncertainty With Prototype Form



literature but an admonishment perhaps no less meaningful for our own, not only cuts short the possibilities latent in the discovery of new discursive spaces (Graham, 1991), but runs the risk of reducing theory to a procrustean bed (Georgiou, 1973).

This concern is exemplified in the recent January, 1992, AMJ article by Parthasarthy and Sethi where the authors attempt to force fit the dynamic integrative design implications of CAD-CAM technology into the inert symmetry of the classical paradigm. The irony, as Julie Graham (1991) points out, is that not only are scholars and practitioners authorized to imitate such conceptually incommensurable mixtures, but this kind of theorizing is often awarded credit for breaking new ground.

The coherence and unity innate to regnant conceptualizations of organization, environment, and "fits" depend on margins that are clear-cut. However, it is the ambiguity surfacing in the wake of the institutional interpenetration taking place on no less than a global scale that is transforming hard, sharp boundaries into a problematic. The apparent disjuncture between the documented scale and reach of institutional interdependencies and the legacy of calibrated assumptions shaping organizational theory warrants an examination of the empirical consistency of organizational boundary. Since conceptualizations of organizations as bounded and predictable entities depend on boundaries being physically there, the possible epistemological ramifications surrounding this issue may profoundly affect how organizational normality and anomaly are represented. *Ipsa facto*, a need exists to focus analysis on the ontology of boundary so that scholars can be more confident in the questions that they ask about organizing. But where



and how is this to be done? The next chapter (3) documents the interdependent condition of American research universities. Chapters 4 and 5 discuss a pragmatic analytic approach to these important issues.

#### Endnotes

1. Anticipating open systems and coalitional concepts, Barnard problematized a settled ontology of boundaries and organizations. Working from a macro-perspective of organizational action, Barnard prodded contemporaries to embrace a more inclusive model - one acknowledging environmental interdependencies. Hence, it is important to recognize that his cooperative ideal of organizing was not exclusively confined to employees ("insides"), but incorporated consumers, suppliers, and other constituents customarily left "outside" orthodox concepts. In Barnard's view, the "material of organizations" actualizes "When the acts of two or more individuals are cooperative, that is, systematically coordinated, the acts by my definition constitute an organization" (Barnard, 1940: 297).
2. Selznick regarded the environment with frank suspicion. In his view management achieved pyrrhic victories at best when attempting to placate external constituencies (see his TVA and the Grassroots, 1949). Parsons tried to introduce a more balanced view of the environment.

## CHAPTER 3

### ENACTING AMERICAN RESEARCH UNIVERSITIES

*The debate within the university centers on how the university can obtain added income from participation in commercial ventures while maintaining its integrity and basic values.*

National Science Board (1982)

#### Introduction

Proceeding from a social constructionist perspective, this research treats university boundaries as contingent social "achievements" (Brown, 1978), and organizational "facts" (environments, hierarchies, rules, rationality, goals, etc.) as things derived (Silverman, 1971; Weick, 1977; Manning, 1982; Riley, 1983; Bartunek, 1984; Ranson, Hinings & Greenwood, 1980; Giddens, 1979; Benson, 1977; Smircich & Stubbart, 1985). Likewise, "organization" itself denotes a precarious ensemble of meanings and processes, tensions and contradictions (Benson, 1977, 1983; Quinn & Rohrbaugh, 1983; Gray, Bougon & Donnellon, 1985).

Accordingly, the university *qua* organization neither qualifies as an island nor a non-contradictory whole. Indeed, the "university" as such does not exist. Rather, "it" is advanced as a socially constructed phenomenon predicated on an ongoing "negotiated consensus" reflecting the self-interested and competing claims of various stakeholders (Cyert & March, 1963; Ansoff, 1965; Ackoff, 1974; Freeman, 1984; Rule, 1988; Freeman, 1984; Quinn & Rohrbaugh, 1983; Quinn & Cameron, 1983; Quinn & McGrath, 1985).

Regarding the substantivity of academic boundaries, then, the interpretive appraisal foregrounds three interrelated themes in the

organizational literature. One, the concept of boundary underscores higher education's embeddedness within and indebtedness to a larger context (Granovetter, 1985; Clegg, 1990). To constitute elite universities in isolation (i.e., surrounded by high fixed walls) as Traditionalists (and to a lesser extent) Instrumentalists are wont to do underplays the reciprocative power relations linking universities to their environments. Second, the dialectical opposition between autonomy and discipline underlying the concept of boundary is a recurring, albeit unresolved, theme in the organizational literature (Barnard, 1938; Argyris, 1964; Lawler, 1977; Giddens, 1979; Perrow, 1986). And third, recognition of the inherent ambiguity of organizational boundary - that social boundaries are always pending - prompts us to regard boundaries as the dialectical dimension (rather than the mathematical space) where people confront their social arrangements (Benson, 1977).

Research universities represent particularly attractive settings for exploring the substance of organizational boundary. For one, important constituencies are currently "negotiating" the normative lines governing "the way science is used in our societies and the way in which it is supposed to be generated" (Introduction to Gibbons & Wittrock, 1985). In addition, important aspects of the concentric theoretical model introduced in the previous chapter are featured in this debate.

"Traditionalists," for example, largely view academic participation as essentially a "moral involvement" (Grimes & Cornwall, 1987). The incursion of remunerative considerations threatens to undo the established normative framework of solidarity and trust (incarnated in publication and peer review) underpinning the open community of scholars. In particular, the university's signifying (core)

educational, knowledge producing and, not least, critical functions are in danger of being compromised by the myopic, profit imperatives driving major business benefactors, regardless of honest intentions. Thus, although the American university exists in a perpetual state of fiscal dependency, making partnerships with government and major industrial interests<sup>1</sup> obligatory; nonetheless, the implications of these power-skewed coalitions for the university's social-organizational structure cannot be underestimated.

The Instrumentalist, on the other hand, visualizes new entrepreneurial university/industry arrangements as mutually pragmatic. The university wins a steady source of research money without an excess of government red tape, help from industry in making new discoveries commercially useful, potential employment opportunities for its students, and stimulating faculty-industry interactions. For its part, industry gains access to new sources of ideas and technology, a source of potential research employees, and the ability to draw on top scientists without having to expand in-house research capacity. In sum, industrial/university arrangements represent a natural and pragmatic closure between university science and the "scientific" vanguard of industry (Stankiewicz, 1986).

These synopses capture the Traditionalist/Instrumentalist antithesis on a factual level. But theoretical purposes require that this opposition be converted into the specifications of the concentric metaphor. For example, as with orthodox organizational theory, both Traditionalists and Instrumentalists share the efficacy of insides (order) and outsides (disorder). That the university and its



environment coexist in a dichotomy of separate realms is taken as fact. But a key theoretical difference separates the two discourses.

Specifically, Traditionalists and Instrumentalists attribute different ontologic meanings (substantivities) to organizational boundary because each situates organization/environmental tensions in a different theoretical place. Traditionalists, as we have seen, concentrate on the integrity of the academy's purported core repository of first principles. In light of the alleged hegemonic reach of the marketplace, the Traditionalist takes every precaution to insulate the core behind a indelible bulwark of permanent, impregnable walls.

Instrumentalists, on the other hand, locate the industry/ university interface at a reasonably safe distance from the core - at the academy's fringes. This theoretical separation, then, allows the Instrumentalist, unlike the Traditionalist, to sleep through the night. Market imperatives notwithstanding, it is not in industry's long-term self-interest to tamper with the academy's core intellectual processes. Traditionalists need to face up to the fact that American universities have never enjoyed an extrahistorical immunity to "worldly motives". Indeed, the Instrumentalist contends, the university's social relevance depends on two-way interactions, not obstructionism. Besides, in addition to the equilibrium inherent in situations governed by mutual self-interest, preservation of the academy's core values is assured as long as the university's distinctive educational and communications mechanisms are contractually sanctioned (buffered) (Reams, 1986).

In sum, two items can be inferred from this discussion. One, the continued unproblematic status of the literature's intellectual core depends upon which discourse ultimately predominates. The moral unity



of the core paradigm is predicated completely on the factual reality of fixed Traditionalist boundaries. The osmotic nature of Instrumentalist boundaries, on the other hand, problematizes the core's exclusive "conditions of possibility" (Miller & O'Leary, 1989). In effect, if coherent boundaries are not validated by our findings, two things happen. The assumed congruence of the core is opened to doubt. Also, theory is nudged closer to adopting a more macro (Barnardian) perspective - one incorporating "insides" and "outsides."

Second, it is consistent to consider the Traditionalist and Instrumentalist discourses as theoretical enactments in themselves. Indeed, the opposition they enact is not the product of a single, privileged reading, but grounded in a genealogy of past events. Just as the concentric organizational model was a response to specific historical circumstances, there is similar cause to articulate the Traditionalist/Instrumentalist negotiation as an ongoing and reciprocal social engagement with a dynamic social environment (Graff, 1985).

Indeed, a strong argument can be made that from the beginning, autonomy was out of the question for an institution charged with the training and enculturation of future generations of American citizens (Wolin, 1981). As both patrons and benefactors of education, industry and the state maintained an abiding ideological interest in curriculum, research and faculty hiring practices (Noble, 1977; Wolin, 1981; Price, 1986). "...the relationship between higher education and social change is circular and interdependent with both transforming each other (Jarusch, 1983: 9). Later, with the consolidation of industry, government and science during and after WWII, the university moved from the sidelines to the center of the nation's modernization process. A

host of factors including the continued academization and scientification of key technologies has opened the door for new profit-motivated business/ university alliances. The following sections describe these developments in more detail.

### University/Industry Relations: An Interpretive History

#### In the Beginning: At Arm's Length

Since the turn of the century and before, corporate philanthropy has supplemented university capital budgets and underwritten university-based research. In return, the American university has supplied industry with "applied, fundamental research, and research manpower" recognized even at that time as essential to the continued development of science-based industry (Noble, 1977: 128). Over the years, the university/industry linkage was strengthened by scholarships, faculty consultancies, research grants and outright gifts. Businessmen served as university trustees as well as benefactors and some academic departments (engineering, natural sciences and management) tailored their curriculums to correspond with industry needs (NSB, 1982). Industries' interest were largely utilitarian. The university contributed by "critically reviewing and systemitizing the accumulated technical knowledge" and trained future workers and researchers (Stankiewicz, 1986). Not least, sponsoring university research has allowed business to shift some of the cost and risk of basic research to the public sector (Noble, 1977; Dickson, 1984).

Although private and industrial endowments played a leading role prior to the turn of the century, colleges and universities continued to stress basic science and teaching. The bulk of Ph.D.s sought work

within the academy. No direct link existed between Ph.D. production and industrial requirements. Although always interested in new discovery, industrial research remained devoted to improving manufacturing processes and the exploration of new product applications. Thus, on the whole, the knowledge transfer mechanisms between the university and industry could generally be characterized as indirect because industrial technology was largely *ad hoc* and empirical.

However, industry interest in university research increased dramatically with the advent of large science-based industries - electrical and chemical - during the first decades of the twentieth century (Baer, 1978). The impetus of the First World War ("the chemists' war"), combined with the mushrooming list of new products emerging from industrial laboratories and independent research institutes served to reinforce industry's linkage to science - and the university. As a result, direct links between the university and industry multiplied. For example, the number of graduate fellowships climbed even during the Depression, gifts of specialized equipment increased along with the practice of industrial consultantships (NSB, 1982: 219-220). But David Noble (1977) cautions that this intensifying relationship was more than a marriage of mutual convenience:

Perhaps more important, it (industry sponsorship of university research) redefined the form and content of scientific research itself. This involved more than the general shift away from the search for truth and toward utility which had already been well underway by the turn of the century. Now the shift toward utility assumed particular forms, molded by the specific, historical needs of private industry...This reorientation affected not only what kinds of questions would be asked but also what particular questions would be asked, which problems would be investigated, what sorts of solutions would be sought, what conclusions would be drawn. Science had, indeed, been pressed into the service of capital (147).

A New Federal/University Contract: The Boom Years 1942-1966

While industry support for university research more than doubled between 1953 and 1966, given the unprecedented infusion of federal monies, its share of total university R&D support declined sharply from eight to two percent (Baer, 1978: 63). Indeed, in the two decades following WWII the federal share of R&D support steadily increased eventually peaking at 74 percent of all university R&D in 1966 and 77 percent of all basic campus research (Baer, 1978: 63). By 1966, colleges and universities accounted for 46 percent of the total funds for basic research. (This figure climbed to 53 percent in 1975.)

"...despite great fiscal pressures, universities managed to increase and consolidate their positions...as the predominant performers of basic research in the United States" (Baer, 1978: 71).

Not surprisingly, the links between the university and industry softened during this period (Baer, 1978; Dickson, 1984). The glamour of high-tech, performance-oriented defense and space related work drew faculty and newly-minted PhDs away from more conventional industrial research. Virtually overnight, academic work was exciting, lavishly funded and with a shortage of Ph.D.s - jobs plentiful. "In an expanding era it all too easy to believe that only the second-rate student or worse need be relegated to industry, government, or nonresearch teaching positions" (Baer, 1978: 86). Industry went begging, prompting a vice president of R&D at Koppers to complain that "Too many (employable candidates) are overspecialized in (disciplinary) training and not interested in broadening their horizons" (Baer, 1978: 86). Other forces were also at work. Specifically, industry's share of total basic research funds slipped from 36 percent in 1955 to 22 percent



by 1966 (to 16 percent by 1975) (Baer, 1978: 66). Among other things, inflation and an uncertain economy in the late '60s and early '70s induced management to emphasize applied over basic research.

Nonetheless, despite these events the original motives for industry/university collaboration remained intact. Indeed, the "systemic institutionalized connection" (Ravetz, 1971: 38) between important science and industry may have actually been fortified. The growing allocation of federal dollars during the war and again in the years between the Sputnik launch (1957) and 1966 helped to prepare the way for the renewed industry/university collaborations that were to follow.

Science and the university were never quite the same again. For example:

- 1) In short order, university science was transformed into Big "industrialized" Science (Ravetz, 1971) - a capital- and labor-intensive activity highly sensitive to cyclical changes in funding patterns. Following the example set by the Manhattan Project during the war, science was hereafter to be performed by large, specialized teams working with sophisticated and expensive equipment. "This change is as radical as that which occurred in the productive economy when independent artisan producers were displaced by capital-intensive factory production employing hired labor" (Ravetz, 1971: 44). No school, much less a department or individual scientist, could afford to pay for research independently. Alliances with outside sources - even government in peacetime - were now taken for granted.



- 2) The immense cost associated with modern laboratory research mandated new forms of accountability and distribution. Henceforth, decisions effecting the content and trajectory of university research were concentrated in a handful of mission-oriented agencies (AEC, NASA, DOD, Office of Naval Research, the NSF, etc.). "With this concentration of powers of decision and control, the free marketplace of scientific results, whose value is established after they are offered and by informal consensus, is replaced by an oligopoly of investing agencies, whose prior decisions determine what will eventually come on to the market" (Ravetz, 1971: 45). Savvy university scientists quickly adapted to this new entrepreneurial (fund-raising) and administrative (bureaucratic) environment. Moreover, the unprecedented expenses involved insured that basic research was concentrated in a few dozen select universities (Muller in Logsdon). Not every campus was awarded a cyclotron.
- 3) The massive infusion of federal funds spawned a widespread R&D infrastructure consisting of university and government laboratories, non-profit research institutions, in-house industrial research, and a new class of federally funded research and development centers (FFRDC's) managed by both universities and industrial firms. The relationships within this R&D network directly correlate with the level of federal support. These relationships, therefore, became highly competitive after federal monies stabilized after 1966-67. In addition, the FFRDC's allowed university faculty opportunity to divide their time between academic and non-academic project

environments and form working connections within business and government. These connections prepared the ground for subsequent complaints about "conflicts of institutional interest" that surfaced in the late 1970s.

4) Formed in the crucible of the Second World War, the tensions of the cold war, and the rise of the new global economy the new alliance permanently binding the university to the needs of industry and the state was built on three on-going rationales directly affecting the autonomy of the university. One, that on-campus research had to acquire more relevance. Relevant to whom and to what ends was customarily decided by whoever was paying for the research. Given the ever rising cost of high-tech research the call for academic relevance was, in effect, self-justifying. For example, Lyndon Johnson wanted expensive university research to serve the (health, environmental, urban and educational) needs of his Great Society program. The Nixon administration used "irrelevance" to justify dismantling many scientific projects (e.g., NASA) after the Vietnam-stretched economy began to manifest symptoms of over-heating (in real terms, federal support for basic research decreased by 10% between 1968 and 1971) (Dickson, 1984: 29). Second, that scientific discovery could be managed, and, if warranted, the scientific establishment mobilized to serve the needs of the state in times of crisis. The Manhattan Project was the archetypical case, of course. But science was to be mobilized by international exigencies again with the surprise launch of the Russian Sputnik satellite in 1957. Since the mid-1970's

university science has been redirected to the specific needs of industry as the Carter and Reagan administrations looked to science and technology to fend off stagflation - and the Japanese; while university officials sought more reliable funding sources. And finally, science was reconceptualized as an investment rather than simply overhead (Dickson, 1984). In other words, even though the contribution of science to economic expansion can only be assumed at this time, science was now deemed central to the expansion of capital and favorable balances of trade. "The theory that began to emerge was that, in the long run, the economy would remain healthy only through a continuous infusion of new technological innovations - and that this could be assured only by continued support for basic science" (Dickson, 1984: 32).

#### 1973 to the Present: The New Consolidation

Juxtaposed to the business/university estrangement of the 1960's, ties between select universities and industry grew measureably stronger over the next two decades. Industry support for total university R&D rose from 3% in the late 1970's to 5% in 1984 (due to the immense federal science budget, industry's share had tumbled from 10% in 1955 to 3% in 1978) (Stankiewicz, 1986:21). Indeed, in constant terms, industrial support doubled between 1966 and 1978 (Stankiewicz, 1986) and expanded by 8.5% per year, on average, between 1981-1984 - surpassing increases in industrial in-house research expenditure (NSB). There were other indicators of change as well. For example, even though employment in high-tech firms was declining between 1981 and 1983, 4,800 doctoral

scientists and engineers (about 3% of the total) moved from the academia to industry, while 1,700 moved in the other direction (NSB). In addition, from 1973 to 1982 the proportion of industry authored papers with academic co-authors jumped from 13 to 24 percent (NSB). This ratio was even higher in biology (50%) and biomedicine and clinical medicine (NSB).

The pendulum is swinging back the other way. Universities are seeking long-term research support, free of government overhead and red tape, and industrial firms are seeking greater control over the direction of new scientific and technological developments and a greater proprietary interest in these developments (Noble & Pfund, 1980). Briefly, this shift is generally attributed to the following factors: (1) Industry's switch in research strategy from "defensive research" (product incrementalism and manufacturing process improvements) to a more product innovative emphasis; (2) America's entrance into a "post-fabricative" era (Rose, 1985) entailing a structural shift away from traditional manufacturing industry to reliance on a new high-tech, science-propelled economy (computers and related industry, genetic engineering); (3) industry's consequent renewed interest in fundamental research sectors (the university); and (4) White House anxiety over the erosion of the country's technological lead to other industrialized nations. As of late, this trajectory has been lubricated with new and more liberal interpretations of patent laws and significant tax breaks for industry research expenditures (the Economic Recovery Tax of 1981). Innovation emerged a national priority in the Nixon, Carter and Reagan eras. Brains had come to represent the new competitive trump card. "...intellectual capital - scientific resources and the aptitude for



technological innovation - constitutes the major asset of industrialized countries in the new modes of international competition and interdependence" (Organization for Economic Cooperation and Development, 1980: 20).

Not surprisingly, the new competitive highground embodied in the mobilization of scientific and technical innovation fostered new linkages between industry, state and university. Overall, these changes entailed a quantum change in science policy. One, support for basic research was to be largely channeled into those areas of research that held promise to make industry more competitive. Particularly under Reagan, the private sector was given the upper hand in setting the research agenda (Dickson, 1984). Second, the application of research outcomes was to be largely determined by the private sector and market forces (Dickson, 1984; Noble & Pfund, 1980).

Unlike the paramount purpose of government-sponsored research with universities where furtherance of the public interest is the goal, industry investments in university research are by desire and obligation centered on the ultimate goal of making a profit....When investing in university research, industry often will place its ultimate profit goal ahead of any service interest to the public at large. With the contracts between industry and universities and the resulting shift from public to private investment in research, a new forum is created which is governed by different rules and goals (Reams, 1986: 107).

The new partnership took many forms, some old and some new. For example, traditional cross-fertilization in the form of increased industrial consultancies, grants and fellowships was reemphasized. "Connections between industrial research associations and universities also gained new prominence" (NSB: 233). But, chary of the relatively fickle nature of federal funding cycles, university administrators and researchers increasingly sought more permanent and stable alliances. In



"Internally," the intensity of mixed-sector interconnections and their possible repercussions on the academy's "practical consciousness" (Giddens, 1979) (the largely tacit knowledge individuals use to define and navigate social environments) has varied by discipline. For example, while the financial condition of the liberal arts remains highly problematic (Daniels, 1989; Berger, 1989), over the last decade university-based researchers in some natural sciences have been allegedly exposed to unprecedented pressure to commercialize their work. These pressures seem to be particularly acute in rapidly developing technologies where innovation depends entirely on large-scale, high-tech research motivated by the prospect of vast commercial reward (Fuchsberg, 1989).

This suggests that no single discourse of science (the academy) can be said to prevail today. Indeed, contemporary scientific discourse might well be characterized as a cacophony of voices. As the Pons/Fleischmann episode indicates, even practicing scientists are experiencing difficulty understanding one another (Raymond, 1989). What is clear, however, is that opinion differs sharply as to the boundaries delineating the spheres of academic and market behavior.

#### Negotiating University Boundaries

From an interpretive point of view, the unanswered question is what are the consequences for the academy's purported core "provinces of meanings" (Ranson, Hinings & Greenwood, 1980) if university-based science is redefined as a business asset? Accordingly, this research treats the Traditionalist and Instrumentalist schools as "rival frames of reference" (Smircich, 1983a) - each denoting a singular "way of

knowing" grounded in perceptions about the function of knowledge (Lyotard, 1979). The Instrumentalist, for example, purportedly values knowledge for its use-value - its potential for product realization. In contrast, the Traditionalist validates the heuristic power of knowledge.

The domain of a particular frame or discourse - "what one chooses to bracket and pay attention to" (Smircich, 1983) - is enacted through linguistic relationships that prescribe the cognitive boundaries of permissible conversational and social intercourse. The university's various constituencies, in other words, interpret action according to the constructed boundaries they set for themselves (inside) and others (outside) (Brown, 1978; Weick, 1979; Putnam & Pacanowsky, 1983; Conrad, 1983).

From this perspective, social boundaries emerge from interpretive consensus or conflict (Conrad, 1983). If the product of consensus, boundaries demarking relatively stable patterns of meaning and structure tend to grow thicker and more opaque with regular use (Berger & Luckmann, 1966). As products of a social context, however, the content and rules of discourse are inherently unstable (Calas, 1987). Disputed boundaries entailing clashes between competing interpretations sometimes lead to structural change. Conflicted boundaries, therefore, figure as boundaries "under discussion."

The partisan split over the contemporary dynamics of university/industry relations qualifies American research universities as prime examples of organizations where boundaries encompassing values, norms, and meaning structures are under discussion. Every opinion composing this discourse radiates outward from the basic pro-market (Lyon, 1982); NSF, 1982; Reams, 1986; Lynton & Elman, 1987; Powers, 1988) non-market

(Noble & Pfund, 1980; Dickson, 1984; Nelkin, 1984; Rule, 1988; Schaffer, 1989) opposition.<sup>3</sup> To enlist with one side or the other, therefore, is to affiliate with a different set of boundaries regarding the purpose of university-produced knowledge, its mode of production and the standards by which it is judged relevant (Lentricchia & McLaughlin, 1990).<sup>4</sup>

Thus, Traditionalists view academic and industrial science as two distinct cultural realms each with its own logic and authority (Nelkin, 1984; Dickson, 1984; Krinsky, 1987; Schaffer, 1989). Research is deemed a form of power and intention and the progeny of a vulnerable (and venerable) social structure. To the Instrumentalist, on the other hand, research is not to be indulged as an esoteric exercise, but employed as a practical instrument of social and economic transformation. As the laboratories of social change, universities are obliged to strike a bargain with the marketplace (Prager & Omenn, 1980; Rosenzweig, 1982; Fowler, 1984; OECD, 1984; Lynton, 1987). Instrumentalists propose to "modernize" campus science by revamping its normative boundaries. Traditionalists prefer to quarantine university science by reinforcing boundaries purportedly already in place. In the final analysis, each perspective wants to impose a different moral structure (Etzioni, 1971; Gibbons & Wittrock, 1985; Grimes & Cornwall, 1987).

A deductive reading of the topical Traditionalist/Instrumentalist literature finds that the opposition between these two frames of reference is replayed along the dimensions shown below. Samples of Traditionalist and Instrumentalist opinion statements used in our subject survey follow each category.

Property - Traditionalists believe that the proprietary logic of the competitive marketplace will drive open intellectual discourse (the

(Noble & Pfund, 1980; Dickson, 1984; Nelkin, 1984; Rule, 1988; Schaffer, 1989) opposition.<sup>3</sup> To enlist with one side or the other, therefore, is to affiliate with a different set of boundaries regarding the purpose of university-produced knowledge, its mode of production and the standards by which it is judged relevant (Lentricchia & McLaughlin, 1990).<sup>4</sup>

Thus, Traditionalists view academic and industrial science as two distinct cultural realms each with its own logic and authority (Nelkin, 1984; Dickson, 1984; Krinsky, 1987; Schaffer, 1989). Research is deemed a form of power and intention and the progeny of a vulnerable (and venerable) social structure. To the Instrumentalist, on the other hand, research is not to be indulged as an esoteric exercise, but employed as a practical instrument of social and economic transformation. As the laboratories of social change, universities are obliged to strike a bargain with the marketplace (Prager & Omenn, 1980; Rosenzweig, 1982; Fowler, 1984; OECD, 1984; Lynton, 1987). Instrumentalists propose to "modernize" campus science by revamping its normative boundaries. Traditionalists prefer to quarantine university science by reinforcing boundaries purportedly already in place. In the final analysis, each perspective wants to impose a different moral structure (Etzioni, 1971; Gibbons & Wittrock, 1985; Grimes & Cornwall, 1987).

A deductive reading of the topical Traditionalist/Instrumentalist literature finds that the opposition between these two frames of reference is replayed along the dimensions shown below. Samples of Traditionalist and Instrumentalist opinion statements used in our subject survey follow each category.

Property - Traditionalists believe that the proprietary logic of the competitive marketplace will drive open intellectual discourse (the



lynchpin of the academic social matrix) underground (Chubin, 1985; Broad, 1988; Bourke, 1989). Instrumentalists answer that varying degrees of secrecy and competition are inherent in the social relations of science (e.g., priority claims) (Rosenzweig, 1982; Hull, 1985).

**Traditionalist Opinion Statement:** *Science is nourished by free and open exchanges of information. There is no place for proprietary knowledge in the academy.*

**Instrumentalist Opinion Statement:** *Modest changes in university rules regarding intellectual property will allow commercial activities to go forward without threatening traditional values.*

Entrepreneurism - The Traditionalist argues that the narrow, self-oriented ethos of capital is diametrically opposed to the deontological traditions of academic science (Werth, 1988; Leary, 1989; Minsky & Noble, 1989). The Instrumentalist replies that academic science today underwrites the nation's military and economic security. Like it or not, in modern societies universities are key factors of production. For those idealists who still entertain doubts, passage of the University and Small Business Patent Act of 1980 and other legislation makes the university's commercial status official (Rosenzweig, 1985; Gupta, 1990).

**Traditionalist Opinion Statement:** *If you make the ethics of academic science the same as Wall Street, you're going to corrupt science.*

**Instrumentalist Opinion Statement:** *There's nothing inappropriate for academic scientists, while holding regular academic appointments, to be proprietors, exclusively or jointly, in private business firms in*

which scientific knowledge gained in their academic capacity is to be used.

Disinterestedness - According to Traditionalists, the existence of a unified scientific community with its exceptional social relationships and functions (the dialectical processes of discovery, education and critique - a sanctuary for tradition, diversity and independent commentary) necessitate an uncommon degree of institutional autonomy (Leavitt, 1988; Wheeler, 1989; Blum, 1990). The Instrumentalist replies that "American universities are among the most permeable of social institutions" (Rosenzweig, 1985: 41). Universities and good science have never existed in isolation, but do their best work when fulfilling societal needs. Corporate and public interest are virtually identical, and commerce is the most efficacious route to public use of academic invention (Prager and Omenn, 1980).

**Traditionalist Opinion Statement:** *Limits should be placed on how much time faculty can devote to outside concerns. The one-fifth rule allowing one day per week is fair and adequate.*

**Instrumentalist Opinion Statement:** *Conflicts of interest can be minimized or avoided altogether by vigilance and good faith.*

Choice and Design of Work - Caldart (1983) conveys the Traditionalist fear of Huxleyian subversion when he writes "the fabric of academic research could be slowly rewoven on industry's loom." Indeed, the practical consequences of such cultural experimentation (university/industry alliances) are clear. More and more academic scientists will come to think like their industry counterparts (Ashford, 1983; Goldman, 1987; Nelkin & Nelson, 1987). Industry may be driven by self-interest, the Instrumentalist admits, but its leadership is not

unaware of the contribution of basic research to the on-going health of commercial infrastructure and corporate competitiveness. This awareness assures that the needs of basic science are not about to be sacrificed for short-term financial gain (Stankiewicz, 1986; Bleveins & Ewer, 1988).

**Traditionalist Opinion Statement:** *With industrial support, there is relatively less freedom for the researcher because there is now a single line to follow, the line of the generous benefactor.*

**Instrumentalist Opinion Statement:** *The legal safeguards built into large corporate-university contracts plus procedural limits established by the university are more than adequate to protect the institutional autonomy of the academic scientific community.*

The Organization of Work - The Traditionalist worries that because large contractual arrangements increase industry's proprietary "presence" on campus (Caldart, 1983), more pressure will be created to remake academic departments into profit centers. In addition, departmental sovereignty will be further undermined by the multi-disciplinary nature of technocratic problem solving (Krimsky, 1987; Minsky, 1989). The Instrumentalist believes that such claims are unfounded (Roy, 1972).

**Traditionalist Opinion Statement:** *Policy concerning university-industry relations should be set and resolved at the department level.*

(Both statements in this category expressed Traditionalist opinion.)

Collectivity - The Traditionalist holds that action occurs at the cultural/structural level; actors create and maneuver within shared social frames that constrain choice (Gibbons & Wittrock, 1985; Rule, 1988; Harris, 1989; McDonald, 1990). Whereas, the Instrumentalist

counters that while prudence is called for there is no hard evidence to show that new university/industry alliances will place any more pressure to sacrifice university traditions than in the past (Rosenzweig, 1982).

**Traditionalist Opinion Statement:** *There are bound to be adverse consequences in terms of collaboration among faculty in various departments if one group must worry about protecting corporate rights to licenses. (Both statements in this category expressed Traditionalist opinion.)*

Quality Control - The Traditionalist is concerned that peer review will be displaced as the marketplace arbiters the direction, process and quality of academic work. Furthermore, the temptation to cheat will increase as independent replicative and quality control mechanisms are bypassed (Fuchsberg, 1989; McDonald, 1989; Crease & Samios, 1991). Instrumentalists hold that formal (contractual) regulations are sufficient to protect the integrity of the academy's formal and informal work practices (Bremer, 1985; Reams, 1986).

**Traditionalist Opinion Statement:** *Corporate sponsorship should be subject to peer review.*

**Instrumentalist Opinion Statement:** *Too much weight is given to the role of peer-reviewed journals in the process of scientific communication. Science doesn't not exist until it is published.*

Reward Structure/Faculty Recruitment Criteria - For a variety of environmental and contractual reasons, the Traditionalist asserts, current university/industry alliances are qualitatively different from the philanthropic relationships of the past (Noble & Pfund, 1980). One result is that grantsmanship activities will be made an integral part of faculty hiring and tenure processes (Holtzman, 1985; Rule, 1988). The



Instrumentalist would likely reply that this is no time to lament a lost (romantic) vision of the world. It might not be a bad idea if all faculty were obliged to develop revenue-generating projects as part of their academic responsibility. Why not make a professor's ability to generate funds a condition of tenure?

*Instrumentalist Opinion Statement: It does not make any difference if the private sector replaces or complements government as the patron of science as long as the professional reward system of academe is preserved.* (Both statements in this category expressed Instrumentalist opinion.)

These oppositions (rendered schematically in Figure 3.1) provide the conceptual building material for the faculty boundary construction to follow. Confidence in the validity of the Traditionalist/Instrumentalist discourse and the ontology of the literature's concepts of boundary, organizations, and environments will depend on how faculty representing different disciplines and market involvements draw their lines. For example, is membership in the academy today motivated by an overriding moral commitment to an altruistic Mertonian ideal<sup>5</sup> (Etzioni, 1971; Argyris, 1975), or are faculty gravitating toward new instrumentally-motivated extramural allegiances (Silverman, 1971; Cummings, 1977; Etzkowitz, 1983) - some conflation of the two, or something altogether novel? The empirical responses to these questions should shed some light on whether the lines constructed by those presumably directly involved in the construction of academic boundaries, i.e., active faculty, validate the *a priori* isolation of organizations and environments.

## VALUES

### TRADITIONALIST

#### The University as a Non-Economic Institution

Classical Form: Knowledge is virtue: university a public investment, public interest science. Clear boundaries between academic and industrial science. Ambiguity accompanies each benefit of university/industry partnerships - a crisis of identity for the university (Noble & Pfund, 1980; Nelkin, 1984; Rule, 1988; Schaffer, 1989).

#### Contradictory Tensions

The tensions emanating from this debate bring out the latent contradictions of the university as a "unity of opposites." These are expressed as explicit antagonisms involving academic norms and practice.

### STRUCTURE

#### Normative Structure

The academy as a collectivity: Commitment understood as a moral involvement. Clear restraints on acquisitiveness and rivalry. The subordination of ego. General references to levels of trust and academic values (Nelkin, 1984; Grimes & Cornwall, 1987; Etzkowitz, 1989).

Property: The limits of ownership of intellectual property; the commodification of knowledge and the issue of secrecy (Nelkin, 1984; Noble & Pfund, 1980; Gibbons & Wittrick, 1985).

Entrepreneurism: Membership characterized by instrumental, calculative involvement. The university is a tool to other ends. Competition valued (Fuchsberg, 1989; Krinsky, 1987; Etzkowitz, 1983).

Disinterestedness: Critical/interpretive function based on intellectual freedom. Allegiance to knowledge alone. Intellectual and political autonomy essential. Sensitive to conflicts of interest (Krinsky, 1987; Schaffer, 1989)

### INSTRUMENTALIST

#### The University as an Economic Institution

Foundation of Industrial Society: Knowledge as productivity. Clear social benefits. The University is an adaptive institution. The object is to strike a bargain with the marketplace. The university is a public and private resource (Lyon, 1982; Reams, 1986; Lynton & Elman, 1987).

### BEHAVIOR

#### Practice/Identity

Choice & Design of Work: Work to be controlled by internal or external constituencies? For science or industry? Applied vs. Basic? The respective emphases on teaching, research, and service (Etzkowitz, 1989; Langitt, et al., 1983; Rosenzweig, 1982).

The Organization of Work: The integrity of departmental structure. Commitments to outside institutions (consulting, advisory roles, etc.). Increasing administrative control; funding patterns (Etzkowitz, 1989; Krinsky, 1987; Noble & Pfund, 1980; Fuchsberg, 1989).

Quality Control: Integrity of peer review process - publication, openness, faculty oversight (Krinsky, 1987; Fuchsberg, 1989; Giamatti, 1983; Gibbons & Wittrock, 1985).

Reward Structure: Sources of recognition and status - based on market or academic criteria? Criteria for promotion (Krinsky, 1987; Etzkowitz, 1989; Rule, 1988; Fuchsberg, 1989; Giamatti, 1983).

Recruitment of Faculty and Students: (Etzkowitz, 1983; Krinsky, 1987; Prager & Ommen, 1980; Minsky & Noble, 1989; Reams, 1986).

Figure 3.1. The Components of Discourse: A Conceptual Schema of the Traditionalist/Instrumentalist Literature

## End Notes

1. Steep entry costs effectively preclude small and medium-size business - see Baer, 1978.
2. For a detailed description of the various forms these relationships take see the taxonomy developed by Nelkin and Nelson (1987).
3. This is not to subscribe to the claim that actors are entirely free from the structure implicit in regularities and commonalities (see Giddens, 1979; Ranson, Hinings & Greenwood, 1980; Manning, 1982; Benson, 1983; Riley, 1983).
4. This claim is grounded in my deductive reading of relevant literature. The themes outlined in Figure 3.1 surfaced time and again.
5. In his classic essay, "The Normative Structure of Science," Robert Merton (1948) writes that the singular object of science, its *raison d'être*, is the "pursuit and diffusion of knowledge" (4). Furthermore, the specialized methods and knowledge base that distinguish the scientific enterprise rest upon a delicate web of explicit and implicit understandings. Merton describes how the "Ethos of Science" is legitimated in the observance of four conditions. These conditions stipulate that scientific inquiry should be: (1) neutral; (2) commonly owned (i.e., "ownership" is limited to claims of intellectual authorship); (3) disinterestedness; and (4) subject to detached scrutiny.

## CHAPTER 4

### RESEARCH PROCEDURES: Q METHODOLOGY - OPERATIONALIZING SUBJECTIVITY

*Only subjective opinions are at issue in Q, and although they are typically unprovable, they can nonetheless be shown to have structure and form, and it is the task of Q technique to render this form manifest for purposes of observation and study.*

Brown, 1986

#### Introduction

This research has three interrelated objectives. One, to survey the perspectives of selected humanities and science faculty regarding the current status of the social relations of academic research. In the main, the Traditionalist/Instrumentalist debate represents the opinion of leading academic scientists, university administrators, corporate spokesmen. Working faculty constitute the missing voice. Where, in effect, do various faculty draw their lines? Second, the perspectives rendered by faculty are compared with (a) the bipolar conceptual dimension indexing the Traditionalist/Instrumentalist discourse and (b) the competing ontologies shaping the concentric theoretical model formulated in Chapter 2. Are historians pure Traditionalists and science faculty Instrumentalists? Or, will faculty opinion organize around mixed or altogether novel frames of reference? Do these models, in other words, adequately describe the phenomena they purport to represent?

And not least, can a mechanism be found to represent the ontology of organizational boundary? For the exploratory purposes of this study, will Q Methodology (Stephensen, 1953; Brown, 1980; McKeown & Thomas, 1988) capture the variety, ambiguity and contradiction - as well as the



regularity - purportedly endemic to the social relations of academic work?

Since this project attempts to explore the frameworks of meaning respective science and humanities faculty draw on to construct the permissible limits of academic practice, some methodological concerns deserve special attention. The empathic "in-the-other-person's-shoes" axiom (Weber's *verstehen* sociology) behind all interpretive research warrants method that is patient, sensitive to variety and ambiguity (Smircich, 1983), and unobtrusive (Brown, 1986). In operative terms, the investigator's operating hypotheses and method of choice must not subordinate the subject's level of experience. Otherwise, we chance reducing the phenomenon of interest to the model's Procrustean specifications (Stephensen, 1983; Daly, 1991) by "elevating the imagination into the status of a universal legislator" (Graff, 1979). Given that the exploratory interest here is not to extend the range of phenomena explicable in the analyst's terms so much as to map the subjective terrain of meanings of a particular discourse, Q Methodology seemed to bring an epistemological orientation and "operational substance" (Brown & Mathieson, 1990) particularly suited for this exploratory task (Stephenson, 1953; Brown, 1981; McKeown & Thomas, 1988).<sup>1</sup>

### Q Methodology

Q Methodology (Q) assumes from the very start that subjective phenomena are not arbitrary nor intangible, but in possession of discernable form. However, the structure of subjective cognitive and evaluative categories can be empirically known only if meanings are

articulated in the respondents' terms. Subjective meaning in Q, moreover, is not free-floating and/or self-contained, but meaningful in relation to social and intra-subjective environment. In Q, as in other phenomenological approaches, the pieces of the jig-saw puzzle find significance in relation to the whole (Steele, 1979).

Accordingly, unlike "R" (Pearson's correlation R) method, Q research does not take standardized statements (e.g., scales, traits) at face value (that variables measure what they purport to measure), but attempts to express a hermeneutic reconstruction. Subject response is not assumed analogous, therefore, to the categorical meanings invented by the investigator *in absentia*. For example, the meaning of a disputed term like "alienation" is not taken as fixed - equivalent, as Brown (1986) puts it, to a degree of Celsius. Fixed meanings are customary in R because it is important to learn how much of a selected attribute (authoritarianism, liberalism, alienation, etc.) someone has. In Q, the subject's view on the matter comes first.

Meaning and measurement in Q, therefore, are not mediated as material "things" external to and independent of the respondent. To the contrary, Q assumes that "reality" is "caused" by individuals and not by "variables" standing in for some external reality. In a word, research categories in Q are not the *a priori* products of the investigator's "arbitrary subjectivity," but made phenomenologically operant by respondents communicating for themselves (McKeown & Thomas, 1988).

#### Procedure

Data are gathered in Q Methodology by having subjects sort cards containing words, concepts, statements or images being explored in the

research. Subjects assemble the various cards into piles according to their own sense of similarity or difference with the contents on the card. The result consists of distributions of cards codifying each subject's interpretation of the phenomenon being studied. In turn, card distributions (i.e., sorts) can be analyzed and compared along with the subjects themselves.

For this study a final Q sample of 66 statements was selected and presented to 31 faculty (14 historians and 17 polymer scientists and engineers at the University of Massachusetts at Amherst). Starting with department chairmen and senior faculty, subjects were solicited for their participation in this study through personal visits to various faculty offices, telephone calls, and written memoranda. The final departmental cohorts represent an attempt to obtain roughly similar dispersions of faculty by age, gender and rank.

In the investigator's presence, all 31 subjects received identical instructions to rank issue statements (each typed on a 3 X 5 card) along a forced choice continuum from "most like my point of view" (+5) to those "most unlike my point of view" (-5). The resultant scale value and requested number of cards per cell are shown in Figure 4.1, below:

Most Unlike	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	Most Like
Cards	(4)	(5)	(5)	(7)	(7)	(10)	(7)	(7)	(5)	(5)	(4)	per cell

Figure 4.1

Scale Values and Cards per Cell

Each subject was initially instructed to separate the entire deck of statements into three piles: those most like your point of view, those most unlike your point of view and those statements with little

psychological value (Brown, 1972). Respondents then selected four statements from the "most like" pile and placed them in cell +5. Each subject then selected four cards from the "most unlike" pile and placed them in the -5 cell. This was followed by selecting the next five "most like" statements for cell +4 and so forth in a back-and-forth mode until all 66 statements were situated along the opinion continuum.

To illustrate, the resulting Q sort for one subject (number 8) is displayed in Figure 4.2, below:

Most Unlike	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	Most Like
Card number	40	50	2	36	44	38	58	31	30	40	39	
	5	15	1	8	66	48	9	13	33	54	32	
	53	65	64	28	6	7	43	56	55	23	17	
	4	61	59	26	19	21	3	12	27	49	29	
		16	11	25	10	23	37	57	52	14		
				41	60	46	63	47				
				35	18	62	51	22				
				42	45	34						

Figure 4.2

#### Sample Q Sort

The 31 Q sorts were correlated producing a 31 x 31 correlation matrix with coefficients indicating the degree of similarity between each Q sort and all others. The matrix was then factor-analyzed using the principal components method. The factors extracted were rotated (using varimax) to a position of simplest structure.

#### Q and R

A major stumbling block to comprehending the logic of Q is that most of us have been trained to think in terms of the mechanics and authority of "R". Perhaps the theoretical orthogonality (not to be



mistaken for bipolarity) of Q and R can be effectively illustrated by referring to the familiar linear correlation formula (Pedhazur, 1973):

$$Y = a + bx + E$$

where Y = the independent variable; X = the dependent variable; a(alpha) = the Y intercept; B(eta) = the regression coefficient; and E = random disturbance or error term.

The epistemological gap differentiating Q from R becomes evident if we examine the way each treats the E term. Because achieving statistical significance is accomplished by smoothing individual differences of subjects in R, (subjective) meaning is deemed idiosyncratic and theoretically controlled by the error term. With respondent subjectivity amputated from context, the error term in R acts to signify methodological detachment as well as the privileged position of the investigator's interpretive schema. Indeed, R validity and reliability are grounded in the autonomous and self-referential conditions symbolized by E. In theory, systematic variance is "impartially" explained in R by isolating meaning from impersonal, non-contentious fact.

Q's relatively spacious, discretionary logic can be disconcerting particularly for those accustomed to thinking in R, because meaning is not a problem in Q. Rather than working to eliminate the E term, Q purposefully strives to make subjective significance the center of theoretical and technical interest. That is, Q (opinion) and R (fact) work from different sets of data (Brown, 1985). Since Q validity hinges on the context of the respondent's hermeneutic narrative rather than "externally" imposed meanings, Q attempts to pry open the black box

symbolized by E. Because subjective rather than "objective" measures are seminal in Q, the investigator and respondent share epistemologic authority.

In sum, the Q analyst's objective is not to find phenomena that neatly fit into preconceived conceptual categories for the purposes of prediction and testing, but to locate and map a natural conceptual topography. The analyst and respondent in Q collaborate to preserve the respondent's voice ("operationalizing" subjectivity) in order to map the aggregate mix of opinion constituting a particular "concourse" (discourse) of research interest (Brown, 1986). Q's particular contribution is its capacity to organize and reduce data in order to clarify the underlying theoretical constructs that might be employed as leading operational categories in subsequent descriptive or correlational analyses (Norusis, 1988), or ethnographic research.

Although Q and R view the ontological status of phenomena from quite different perspectives, the investigator is not necessarily trapped into an either/or choice. It is perhaps more constructive to think of Q as a source point for R (Brown, 1980). In effect, Q functions as a conceptual staging area generating heuristic leads for the subsequent correlational or qualitative analyses that may follow. If the meaning of the role and activities of research schools is changing in the minds of interested parties, then Q offers a systematic empirical method midway between positivist and ideographic approaches for surveying the new lines along which the reading of universities is occurring.

Considering that the concepts and mechanics of Q methodology may be unfamiliar to some readers each of the technical steps outlined above is discussed in more detail in the sections that follow.

### Q Statements

To examine the competing contentions of the Traditionalists and Instrumentalists, a final representative sample of 66 Q statements was drawn from over 400 statements derived from the investigator's deductive reading of the literature (see Figure 3.1). Secondary source material included journal and newspaper articles, government publications, books, and congressional testimony.

In light of the sheer volume of statements (400+) harvested, the first priority was to trim this number down to practical size. Many of the original statements were redundant and consequently dropped. Further reductions were achieved after a sample of the remaining statements was cross-validated by two independent reviewers. Statements determined to be ambiguous or duplicative were eliminated.

### Q-Sample Pretest

A Q-sample of 79 statements was coded and printed on 3 x 5 cards for pretesting. Twelve graduate (Ph.D) students (four each from the departments of Economics, History and Polymer Science & Engineering) participated. Subjects were instructed to sort the 79 statements along a (-5) "most unlike my point of view" to (+5) "most like my point of view" choice continuum. On average, students required about 70 minutes to complete the 79 card Q-sort.

To examine how students were sorting, two iterations of Principal Components factor analysis were performed; once on the complete 12

subject sample and a second time with the four economic students excluded. (The economics students were dropped from the second analysis because the final subject sample enlisted History and Polymer Science & Engineering faculty only.)

The 12 subject analysis produced two factors with eigenvalues of 5.55 and 1.26. These two factors accounted for a cumulative 56.8% of variance. Factors did not undergo substantive modification with rotation indicating strong factor structures. The eight subject sample also produced two strong factors with eigenvalues of 3.60 and 1.11 respectively. Cumulative variance explained rose to 59%. The factor structures for both analyses indicated that pretest subjects were not sorting randomly. In other words, the statements were sufficiently meaningful for the test subjects to categorize statements in a systematic manner. Since the purpose of the Q statements is to elicit a strong positive or negative response, statements consistently assigned to low to neutral meaning cells eg. -1, 0, and +1 were trimmed, reducing the final Q-sort to 66 cards.

In the end, the Q sample administered to the faculty sample numbered 66 statements divided in near equal proportion between Traditionalist (non-economic) and Instrumentalist (economic) attitudes. In addition, statements covered nine issue areas: (1) collectivity (2 statements), (2) intellectual property (11 statements), (3) faculty entrepreneurship (6 statements), (4) disinterestedness (15 statements), (5) project choice and work design (3 statements), (6) the organization of work (2 statements), (7) quality control (4 statements), (8) reward system (2 statements), and (9) faculty and student recruitment (2 statements). (Consult the schema of conceptual categories displayed in



Figure 3.1, page 53). A complete 66 card inventory of statements can be found in Appendix B.

Statements representative of each main effect (the non-economic [category 1] and economic [category 2]) as well as the normative and structural sub-categories resonating from each were selected in approximately equal numbers. It was decided, for example, that the following statement represented the University as a Non-Economic Institution (classical Traditionalist in Figure 3.1):

Expensive, well-publicized corporate/university partnerships are dangerous not only for the threats they pose to the traditions of academic science, but because other institutions will use these instances as "models" of the way university-industry agreements ought to be.

The University as an Economic Institution (Instrumentalist in Figure 3.1) orientation was reflected in the following example:

A more applied orientation will be good for American university science, reducing the academic isolation that developed during earlier postwar periods.

A Traditionalist Intellectual Property position is expressed in the following statement:

The only "property rights" allowable for scientific discoveries are the scientific honors and rewards that derive from recognition of their originator.

Whereas, an opposed (Instrumentalist) Intellectual Property opinion reads as follows:

Some infringements of the university's principle of free dissemination of information should be allowed on a case by case basis in order to protect the university's financial interest.

#### Factor Analysis

Factor analysis in Q is a straightforward statistical exercise for unearthing the various attitudinal groupings implicit in the correlation

matrix. Each factor in Q represents a category of operant subjectivity; i.e., persons significantly associated ("loaded") with a given factor are assumed to share a common outlook. Thus, an individual's positive loading on a factor indicates his or her shared subjectivity with others on that factor. Conversely, negative loadings are signs of rejection of the factor's perspective. The portfolio of factors that ultimately emerges depends on how divided an audience is on a particular issue.

#### Factor Interpretation

The previous steps are requisite "to prepare(ing) phenomena so that they can display their structure" (Brown, 1985: 115). And this implicit structure resides in the "patterned relationships" of statements made operant by individuals performing Q sorts. Each factor, then, represents a generalized attitude or Gestalt or, as in this case, a general conception of "the ethos of academic life" held in common by the persons grouped by factor.

While it is axiomatic that "order" precede "meaning" in Q, Q factors never lose their "fundamentally operant" and provocative nature. Unlike R, therefore, the process of factor interpretation, commences only after factors surface and remains open to further testing and reevaluation (Brown, 1986).

With Q, factor descriptions and interpretations are based primarily on factor scores (and factor loadings) (McKeown & Thomas, 1988). Examining the factor scores of selected statement items across factors assists in the search for the basic themes distinguishing the internal perspectives of important factors. To facilitate this process, the factor scores assigned to each individual statement are merged into

distinct factor arrays which function as composite Q-sorts for each factor. Arrays are typically placed side by side for viewing and analysis. Differences and similarities in factor scores by statement item provide the basis for description and theorizing (Brown, 1980).

Factor scores were calculated in standard (Z) score units for each of the 66 statements and then arrayed in columns by factor. For convenience Z scores were converted into whole numbers (-5, -4, -3, -2, -1, 0, +1, +2, +3, +4, +5) to simplify comparisons of the thematic content of different factor arrays. For illustrative purposes, partial arrays are shown in Table 4.1 below.

Table 4.1

Examples of Statement Factor Scores Arrayed by Factor<sup>2</sup>

Statement #	Factor A Scores	Factor B Scores
1	+1	-1
2	+2	-1
3	+3	+5
4	+3	0
5	+2	-1
6	+1	+2
7	+1	+2
8	+3	+1
9	+1	+4
10	+2	0
.	.	.
.	.	.
.	.	.
66	+5	+3

Table 4.1 table shows the composite factor scores for the Q-statements shown. Statement 1, for example, failed to excite subject interest in either factor. Statement 3, on the other hand, induced stronger responses (+3 and +5). Every statement for each factor's

composite array is scored in this manner making intra- and inter-factor comparisons possible.

#### P-Sample

The selection of appropriate questions and subjects constitutes the two most important procedural aspects of any Q study. Since the exploratory purpose of Q research is not concerned with assigning subjects to predetermined categories, but mapping the typology of opinion implicit in the communication discourse in question, neither randomness nor large sample size are material. The size and composition of person (P) samples is governed exclusively by pragmatic and theoretical concerns (McKeown & Thomas, 1988).

In light of the binary theoretical dimensions segmenting the literature, subjects were recruited from two disciplines (History - 14 members, and Polymer Science & Engineering - 17 members) hypothesized to represent bipolar opinions (humanities vs. hard science) concerning university/industry relations. The idea of a science/humanities break is not new, of course. In his influential book, The Two Cultures and the Scientific Revolution (1959), C. P. Snow describes university environments as consisting of two powerful sub-cultures - one occupied by scientists and the other by literary intellectuals. Viewing the world in radically different terms, each remains isolated from the other. Weber, too, partitioned the cultural world into three distinct spheres - science, morality (eg., law and medicine), and art. [See Richard J. Bernstein (ed.), Habermas and Modernity (1985).]

In other words, the intention here was to examine the major conceptual features of the Traditionalist/Instrumentalist antithesis and



organizational theory with faculty operating at the boundary, i.e., those whose work required regular and extensive contact with industry (polymer scientists), and another set nearer to the "core", i.e., faculty with virtually no market exposure at all (historians).

Although it might be perceived otherwise by readers accustomed to random sampling modes, this qualitative (nonrandom) sampling strategy actually entails no assurance that Traditionalist and Instrumentalist positions would materialize as hypothesized. On the contrary, like other forms of inquiry, results could not be controlled for (known) in advance, only conceptually anticipated. Logic anticipated different perspectives, but the risk of coming up (empirically) empty handed was real. For example, the analytic reading of the literature might have been incomplete. Or, even if our deductive analysis of the Traditionalist/Instrumentalist literature was acknowledged as valid there was no way to know in advance if faculty constituted their world in Traditionalist/Instrumentalist terms. Everything considered, sampling faculty from the alleged classical intellectual divide embodied in the humanities and the hard sciences seemed to constitute a reasonable test. Participants were also asked to complete a brief background questionnaire. Some of these demographic data appear later.

#### The Two Departments and Their Relations with Industry

Both departments are recognized in their respective fields. The History department dates back to the university's founding in 1863 and currently hosts 40 full-time tenured or tenure track members. Faculty engage in teaching and research in a variety of areas including Ancient, Middle Eastern, and Latin and North American history, Labor Studies,

Black and Feminist history, studies in Western Technology, etc. Departmental (salary) expenditures amounted to \$1,919,121 for FY 1990 (source: Dept. of History). The department received one direct (humanities) foundation grant for \$1469 in FY 1991 (source: Office of Grants and Contracts). Not unexpectedly, the faculty surveyed in this study hold no patents, with one exception do not advise industry (and not for profit); and besides book royalties, derive no direct monetary support from industry.

If the History department is unique for its low level of grant support, the Polymer Science and Engineering Program functions in a radically different arena. Launched as a modest graduate program in 1967, the PSE Department expanded into a university department in 1974. Currently, PSE operates with 13 full time and several adjunct interdisciplinary faculty with over 150 graduate students and visiting scientists in residence (Polymer Symposium, May 16, 1991). Research experience in industry for senior faculty averaged seven years. Over 50 companies and several government agencies support research and advanced degree programs. In FY 90-91 the department received a little under \$1M (salaries) from the state and \$7,571,200 in direct and indirect grants from the National Science Foundation (24%), Department of Defense (39.4%) and industry (36.6%) (Polymer Symposium, May 16, 1991). In addition, the department signed a three-year, \$1,200,000 research contract with AKZO America and a \$2M five-year deal with IBM. PSE will officially come of age when it moves to its new \$57M, 160,000 square foot headquarters, the Conte Polymer Research Center, in April, 1994.

Over and above state support, the department maintains six major funding programs for underwriting its research and teaching activities.

The Center for UMass-Industry Research on Polymers (CUMIRP) is the most prominent of these programs and of particular interest to this research - 16 of the 17 scientists surveyed are active members of CUMIRP.

Inaugurated in September, 1980, under the NSF Industry-University Cooperative Research Center Program, the official goal of CUMIRP "is to develop a sound research base in key areas of polymer science of interest to industry participants" (Graduate Program in Polymer Science & Engineering, 1989). Twelve industry and two government agencies underwrite CUMIRP research. Membership fees are currently fixed at \$40,000 per year. Recent sponsors included AKZO, American Cyanamid, Hoeschst-Celanese, Dow, DuPont, Eastman Kodak Co., General Electric, IBM, Olin, Rohm & Haas, Army Laboratories, Natick and Watertown, Mass., and the Lawrence Livermore National Laboratory, Livermore, Calif. The National Science Foundation is a member on a continuing basis. In addition, the NSF contributes another \$93,000 in support of four smaller projects boosting the total 1990-91 CUMIRP budget to \$693,000 (conversation with Dr. S. W. Kantor, Director, CUMIRP). The 1991-92 budget projection is \$823,200. (However, this estimate faces some obstacles. At this time, 12 contracts are slated for renewal. In addition, one company recently cancelled its membership as part of a cost-cutting effort.)

CUMIRP membership entitles sponsors to non-exclusive, royalty-free U.S. and foreign licenses to CUMIRP inventions. Patent rights remain the property of the university, however. Participating faculty have the right to publish in scientific journals, but sponsors may review manuscripts beforehand. Although no patents have been filed to date, sponsors interested in filing patent claims may delay publication up to



one year. An Advisory Board composed of members from industry and the University meets semi-annually to decide and approve policy and research projects.

#### Faculty Demographics

The faculty sample comprised thirty-one (31) full-time faculty at the University of Massachusetts, Amherst - 14 History faculty and 17 members of the Polymer Science and Engineering department. The mean age of the faculty sampled was 49 years (32 to 69 years). Research and teaching experience averaged 16.5 years (1 to 40 years). Twenty-four (24) faculty were tenured (associate rank or senior).

The 14 history faculty averaged 48.5 years of age and 16.7 years of teaching and research experience. Five faculty in this group were women. Nine faculty were tenured. No subject in the history cohort had filed for a patent claim, had sat on a corporate advisory board, or had received any research support from industry during their academic careers.

On average, polymer science subjects were likely to be 49 years old with 16.2 years of academic experience. Fifteen (15) out of seventeen (17) were tenured. There were no women faculty in the department at the time of this study. Seven faculty owned patents, ten had or were currently sitting on corporate advisory boards, and 37.5 per cent of this cohort's research and teaching activities was underwritten by industry. Industrial research experience for the most senior faculty averaged seven years.



### End Notes

1. In addition, the charged atmosphere surrounding the issue of university-industry relations also influenced our choice of methodology. If possible, we wanted to avoid the complaint of self-reporting bias clouding the credibility of earlier questionnaire research (see Krinsky, Ennis, & Weissman, 1991). As compared to these approaches, the process of Q-sorting seems to provide subjects with the requisite level of privacy and anonymity for dealing with sensitive subject matter.
2. The factor scores are the same scale numbers as they appear in the forced choice continuum organizing every Q sort, i.e.,  
Most Unlike -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 Most Like.

## CHAPTER 5

### RESEARCH RESULTS AND DISCUSSION OF FINDINGS

*The factors in Q methodology are categories of operant subjectivity (Stephenson, 1977) that were inherent in the concourse originally, for it was these separate attitudes (the existence of which the factor analysis demonstrates) that gave rise to all the conversation initially. What begins as subjective communicability, therefore, is prepared for viewing through "the midwifery of Q methodology," as Barchak (1984: 118) has nicely put it, and is eventually manifested as operant factors, which, in turn, display the form and structure of the communicability at issue.*

Brown (1986)

#### Introduction

Q methodology assumes that underlying subjective structures can be made manifest or "operant" by providing respondents an unobtrusive medium to model their respective points of view. Accordingly, faculty Q-sorts are analyzed in this chapter in an attempt to literally visualize how faculty "see" their organizational experiences firsthand. Following the procedure outlined in the previous chapter, 31 faculty subjects modelled their subjectivity by rank ordering (Q-sorting) 66 statements along a continuum of interest. All 31 Q-sorts were intercorrelated resulting in a 31 x 31 correlation matrix. Factor analysis was then carried out.

The factor solution produced two major factors, A and B - two distinct (uncorrelated) clusters of opinion with 17 respondents significantly identified with one factor or the other (see Tables 5.1 and 5.2). Each stood out with regard to relative eigenvalue scores, variance explained and variable (subject) size. Both factors A and B displayed eigenvalues (EV) well in excess of the conventional threshold of 1.00, ie., EV = 8.046 and 6.58, respectively. In addition, factor A

Table 5.1

Factor Loadings and Subjects  
(H - Historian; P - Polymer Scientist/Engineer)

Factor	A	B	C	D	E
Subject	H12 .867	P17 .751	P1 .720	P8 .856	P2 .698
	H14 .854	P16 .722	H7 .691	P15 .472	P11 .670
	H1 .799	P10 .698	P12 .652		P3 .545
	H5 .791	P4 .636			
	H4 .777	P6 .604			
	H6 .768	P9 .516			
	H9 .739	P14 .418			
	H2 .636				
	H10 .636				
	H11 .592				
EV =	8.05	6.58	1.64	1.58	1.28
%Variance	26	21	5.3	5.1	4.1
Factor	F	G	H		
Subject	H3 .814	P13 .722	H8 .683		
	H13 .568	P5 .574	P7 -.392		
EV =	1.17	1.06	1.03		
%Variance	3.8	3.4	3.3		

accounted for twenty-six (26) percent of total variability explained. Factor B accounted for 21 percent for a cumulative percentage of 47.2 percent. Factor loadings for each factor are significant at the 0.01 level.<sup>1</sup>

Even at this early juncture the factor analysis yields four tentative leads. One, the two principal factors, A and B, are split along departmental lines. A plurality of historians and polymer scientists and engineers have Q-sorted orthogonal perspectives. Second, the appearance of composite (homeless) subjects such as P14 and P7 as well as the six residual factors signals the possibility of categories other than the pure, two-dimensional (Traditionalist/Instrumentalist) types featured in the literature. (Subject P14 loads virtually equally

Table 5.2

## Complete Factor Loadings

## FACTOR

	A	B	C	D	E	F	G	H
H12	.86746	.03314	-.12944	.05538	.10310	.02622	.00673	.19894
H14	.85466	.02344	-.21507	.02383	-.06296	-.12622	.15163	.02623
H1	.79931	-.01003	-.10899	-.17346	-.09353	.04519	.04089	.04320
H5	.79147	-.03998	.10311	-.09930	.08075	.04967	-.09775	-.07414
H4	.77722	.02401	.10114	.01254	.24325	-.08271	-.13680	-.11760
H6	.76848	.09190	.12772	.19754	-.28687	.08616	-.04873	.11102
H9	.73901	-.08734	.11829	-.00752	.05001	.16985	.02138	.66075
H2	.67665	.14729	.12281	.41106	-.15125	.13798	-.02926	-.14237
H16	.63648	-.22583	-.34224	.13700	.23709	-.04203	.14510	.16601
H11	.59294	.25678	.15401	.01605	.01311	.00606	-.40801	.29426
P17	.16511	.75163	.16346	.17054	.21658	-.02581	-.03208	.01742
P16	.14491	.72202	-.18950	.34097	.19879	-.08898	.09354	.01099
P10	-.33191	.69825	.18011	-.01323	-.01414	.22979	.21550	.12668
P4	-.29937	.63606	.30558	.06419	.19226	.21829	.06513	.10460
P6	.07105	.60489	.37105	.06760	.09703	.11928	.14605	-.20211
P9	-.12211	.51612	.38505	.51073	.03723	-.12764	.26357	.16188
P14	.38964	.41822	.02861	.00709	.20395	.26214	.14590	-.20922
P1	-.14245	.33703	.72056	.17005	.04316	.05910	.00585	-.01830
H7	.30468	-.06230	.69173	-.07376	.28506	-.18127	.24961	.06224
P12	-.04977	.32277	.65270	.28405	.07372	.39564	.08957	.17721

Continued on the next page.



Table 5.2, continued:

	FACTOR							
	A	B	C	D	E	F	G	H
P8	.03125	.17479	.13531	.85618	.17274	.09648	.08708	-.07848
P15	.37168	.42195	-.04672	.47276	.12571	.25500	.00205	-.14136
P2	-.03504	.41538	.14300	.21227	.69810	.21117	.12467	.17608
P11	.22546	.42881	.13638	-.00057	.67038	.13946	.00236	-.22036
P3	-.12025	.15230	.15630	.31169	.54559	.44602	.05928	.09293
H3	.07936	.14349	.01726	.02486	.16502	.81456	.19210	-.09511
H13	.47888	-.01107	.01540	.14814	.13716	.56808	-.10050	.33124
P13	.06587	.40708	.17115	.05609	.00462	.29382	.72213	.04785
P5	-.14423	.28330	.20689	.34572	.41058	.04100	.57479	-.05167
H8	.44625	.06748	.12253	-.12277	.03656	.01935	.00217	.68347
P7	.37467	.27588	.34671	.34410	.02804	-.05585	-.39223	-.39223

on factor A (.39) and factor B (.42). P7 displays equivalent associations across factors A (.37), C (.34), D (.34).) Third, among other things, the presence of the six residual factors demonstrates the presence of within-discipline divisions (i.e., not all historians think alike). And last, generation, and gender, have emerged as possible issues for future inquiry. (For more commentary regarding gender and generation turn to Appendix D.)

### Interpretation

The analyst works with many degrees of freedom in Q Methodology. As Brown (1985: 113) explains, Q is:

...expressly devoid of normative presumptions, and hence there is no standard set of Q items for any study, no standardized statements, no standard number of statements, no fixed number of factors, no fixed algorithm for factor rotation (e.g., varimax), and no standard distribution.

The same degree of flexibility applies to factor interpretation as well. If the analysis is to accomplish more than mere description, the investigator has to be prepared to slip into the respondents' shoes (Brown, 1989). "Empathy" is achieved when the investigator learns to think what the Q-sorters were thinking and in their terms.

Typically, the literature provides no clear criteria for gaining hermeneutic entrance. The investigator is essentially left on his or her own. If the Q literature provides any clue at all it is that analysts customarily attack the problem of interpretation in part or all of the following ways. Depending on what the investigator is trying to accomplish, inferences can be drawn from consensual or negatively consensual statements (Vajirakachorn & Sylvia, [1990]), from statements

located at the extremes of composite Q-sort distributions (the statements found under the +5 and -5 cells) (Brown & Mathieson [1990]), by scanning for comparisons across factor arrays (Patterson, 1982), or, as we have decided to do here, by employing all of these strategies.

Brown (1986) customarily embarks on his interpretive process by applying Stephenson's (1983) "Sontag" rule. He spreads every statement constituting each factor's composite attitude (Q-sort) out for viewing and then strives to "see more, hear more, feel more" of what each factor expresses before deliberately interpreting the impressions that emerge from this intuitive process. We will honor his example with a preliminary visual survey of the entire (66 card) Q-sort distribution. However, not unmindful of the general interpretive context rendered in the 66 card display, we find the thought of grappling with the entire deck visually and analytically overwhelming. We risk missing something important.

We propose that a richer understanding can be gained by subdividing the deck into more manageable-sized categories. The cards in each category are then organized into display maps for purposes of visualization and interpretation. Indeed, most Q investigators proceed in an incremental manner. Only in this instance we intend to rake through the data a little more finely and incrementally than most. If, as Brown claims (1986), seeing precedes hearing and feeling, then hopefully, the extraordinary emphasis on visual mapping used here will create a window to the patterns implicit in the data, thus rendering them visible. So, following Brown's (1986) recommendation, the respective Q-sorts for Factors A and B are arrayed in Tables 5.3 and 5.4.

Table 5.3<sup>2</sup>

Distribution of Factor A Statements  
(Historians Only)

Most Unlike									Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
2.6	3.9	2.9	3.10	2.2	2.10	1.1	1.2	1.3	3.6	4.9
	4.8	4.2	3.14	2.5	4.1	1.6	1.5	1.4	9.7	8.3
	6.3	4.6	3.16	2.11	5.11	1.7	1.10	1.8		11.2
	11.1	5.4	4.4	2.14	9.3	1.9	3.7	1.11		
		7.1	4.7	3.5		2.3	3.8	3.4		
			4.10	3.11		3.2	4.3	3.12		
			4.15	5.1		3.13	5.7	3.15		
			6.2	10.2		3.17	5.9	4.5		
			9.1			9.5	7.2	5.5		
							7.4	8.5		
								10.5		

Table 5.4

Distribution of Factor B Statements<sup>3</sup>  
(Polymer Scientists Only)

Most Unlike									Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
11.1	-	2.6	3.17	1.1	1.4	1.8	1.6	2.11	1.9	1.3
		4.6	4.1	1.2	1.10	3.8	1.7	3.4	2.3	2.5
			9.1	1.5	1.11	3.9	2.9	3.6	3.12	2.10
			10.2	3.7	2.2	5.1	4.2	3.10	4.15	2.14
				5.9	7.4	6.3	4.5	3.13	5.4	3.2
				9.7		9.5	4.9	3.14	7.2	3.5
						10.5	8.5	3.16		3.11
							9.3	4.3		3.15
								11.2		4.4
										4.7
										4.8
										4.10
										5.5
										5.7
										5.11
										6.2
										7.1
										8.3



## Discussion of Complete (66) Card Distributions by Major Factors A & B

What do these patterns initially suggest? Broadly speaking, the composite configurations of card placements for each factor show that Factor A statements are fairly evenly divided between negative and positive attributions; whereas, Factor B statement placement is heavily skewed toward the positive ("most like") side of the sort. Indeed, the +5 cell in Factor B contains 18 statement items, twice as many as any of the other cells in that factor. By comparison, the +5 cell in Factor A contains only three items. As a group, the historians (Factor A) placed a total of five cards in cells +4 and +5, while the polymer scientists placed nearly five times as many or 24. If the most polar cells are indicators of the level of respondent interest then these different patterns suggest that the polymer scientists are more strongly moved by the cards on the whole than their historian counterparts. Perhaps the historians' relatively cool response is due to the fact that their concerns are different or not as immediate as the polymer science faculty. Indeed, after sorting statements some historians commented that they placed a large number of statements in the -1, 0, and +1 cells because many of the issues in the Q-sample were unfamiliar to them.

Are there any clues regarding Traditionalist or Instrumentalist values to be found in these sorts? Leaving the analysis of the statement contents until later, let's try to facilitate visualization of tentative patterns by purging each composite Q-sort of everything but two categories of statements - non-economic (Traditionalist) items (coded category 1) and economic (Instrumentalist) items (category 2) and "see" what comes to mind (Tables 5.5 and 5.6).

Table 5.5

Distribution of Non-Economic (Category 1) - "Traditionalist" and Economic - "Instrumentalist" (Category 2) Statements in Factor A (Historians)

Most Unlike									Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
2.6		2.9		2.2	2.10	1.1	1.2	1.3		
				2.5		1.6	1.5	1.4		
				2.11		1.7	1.10	1.8		
				2.14		1.9		1.11		
						2.3				

Table 5.6

Distribution of Non-Economic (Category 1) - "Traditionalist" and Economic (Category 2) - "Instrumentalist" Statements in Factor B (Polymer Scientists)

Most Unlike									Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
		2.6		1.1	1.4	1.8	1.6	2.11	1.9	1.3
				1.2	1.10		1.7		2.3	2.5
					1.11		2.9			2.10
					2.2					2.14

Discussion of Category 1 and Category 2 Statement Distributions by Faculty Cohorts

The distribution of category 1 and category 2 statements should provide a provisional index of how strongly "Traditional" or "Instrumental" each factor is weighted. First notice that all of the category 1 statements in Factor A are situated to the right of "0" or in the positive spectrum of that factor. All the category 2 statements, conversely, are located to the left of zero (save for one item at the midpoint [2.10] and another under the +1 cell [2.3]). Moreover, the Traditionalist statements (category 1) are concentrated in cells +1

through +3. Interestingly, cells +4 and +5 are vacant. This may indicate that the sample of history faculty is not as firmly wedded to Traditionalist values as originally hypothesized. The modified polymer factor (Factor B) Q-sort is also provocative. For example, cards from both categories are virtually evenly divided (five category 1 items and six category 2 items) between cell +1 to cell +5, although twice as many category 2 items (four to two) are found in the +4 and +5 cells. As shown, five category 1 statements occupy the 0 and -1 cells and one outlying category 2 item languishes in the -3 cell. Again without having examined any statement contents, this pattern may suggest a significant degree of ambivalence. Although the polymer scientists in Factor B lean toward the Instrumentalist perspective, they seem to represent a value mix rather than a pure type.

What do these first impressions suggest? At this superficial level, at least, the Q instrument appears sensitive to variety and ambivalence. That is, it demonstrates, if only tentatively at this point, a capacity to probe beneath crude univocal categories. Second, the preliminary findings hint that historian and polymer science cohorts operate with different value systems. Third, the possible presence of a diversity of academic norms and values weakens the unitary (structuralist) theory of organization assumed in the Traditionalist and Instrumentalist literatures. Indeed, the discovery of two orthogonal factors clearly indicates that faculty do not speak with one voice on these issues.

Some areas of agreement exist, however. For example, both factors pay tribute to several Mertonian norms (category 1 statements) and

reject statement 2.6. Perhaps these (departmental) distributions suggest that while "Traditionalist" and "Instrumentalist" categories may exist, they are more complex than the literature allows for.

Before considering factors A and B individually, it may be instructive to examine the opinions common to both factors - those 16 statements that gained essentially the same score across both factors.<sup>4</sup> Let's examine the most positively consensual statements along with their factor scores arranged from the most positively salient down (Table 5.7).

Table 5.7

Distribution of positively consensual statements in Factors A and B (Factor A statements in parens)

Most Unlike						Most Like					
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	
						(1.6)	1.6				
						(1.7)	1.7				
						3.8	(3.8)	3.4			
								3.6	(3.6)		
								(3.12)	3.12		
							(4.3)	4.3			
							4.5	(4.5)			
							8.5	(8.5)			
						9.5				8.3	
						(9.5)				(8.3)	

List of Positively Consensual Statements with Factor Scores

	Statement	Scores	
		A	B
8.3	Market forces have always been a part of the shifts among posts in U.S. academia, but now the scale has dramatically altered their significance. These have created rifts within the faculties of each institution; the humanities and social science faculties often feel that they are being neglected.	+5	+5
3.6	The pattern of collaboration between large universities and large corporations may be a familiar one. But the implications for the use of taxpayers' funds and the danger of conflicts of interest that these agreements raise require renewed evaluation.	+4	+3



3.12	Universities should also be worried about "conflicts of commitment" - situations where faculty members neglect their academic duties in favor of pursuing other activities, such as consulting outside the university.	+3	+4
3.4	Scientists who shift their attention to the economic benefits of research or who hold equity in firms that market scientific discoveries cannot, at the same time, serve society as disinterested experts on the impacts of the new scientific technologies.	+3	+3
4.3	The unwillingness of academic researchers supported by industry to make research results public will slow the research process of colleagues.	+2	+3
4.5	Science is nourished by free and open exchanges of information. There is no place for proprietary knowledge in the academy.	+3	+2
8.5	There are bound to be adverse consequences in terms of collaboration among faculty in various departments if one group must worry about protecting corporate rights to licenses.	+3	+2
1.6	The question for the '90s is whether universities are to be public-sector institutions spending public money or private-sector institutions supported with public money.	+1	+2
1.7	It's always a mistake to reduce support for fundamental science in order to address things you may think have more immediate applications.	+1	+2
3.8	Researchers should pledge that, while a study is in progress, they will not hold stock in the companies making or distributing the products being evaluated.	+2	+1
9.5	Given industry's investment in university research, it's not surprising that industry should want to extend its control into the "untouchable" area of peer review.	+1	+1

#### Discussion of Positively Consensual Statements

Notice that each of these statements endorses the non-economic values of classical, Mertonian science - disinterestedness (3.8, 3.4, 3.12), free exchange (4.3, 4.5), the pre-eminence of a collective ethos

(8.5, 8.3). But these statements also carry an undertone of concern - of trespass? - that orthodox values are at risk of being overrun by antithetical market values (8.3, 3.6, 9.5). Both factors seem to share a concern about the emphasis of current events. Will too much emphasis on market priorities, for example, result in a deemphasis on basic research (1.7), deepen the alleged rift between science and humanities faculty (8.3) and even immediate colleagues (8.5)? Is the seminal principle of free-sharing going to be respected? The uncompromising tone found in some of statements (4.5, 1.7, 3.12, 8.5) could be taken as an indication of how serious the situation is perceived to be. The market, for example, constitutes a force that recognizes no limits (9.5, 8.3). The boundaries defining the roles of faculty (3.6, 3.8, 3.12, 8.3, 3.4, 9.5) and the fundamental purpose of the university (1.6) itself have become porous and fuzzy.

As shown in Table 5.8, similar inferences can be drawn on the basis of those statements achieving a negative consensus.

Table 5.8

Distribution of Negatively Consensual Statements in Factors A and B

Most Unlike									Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
(11.1)	11.1	(4.6)	(9.1)							
		4.6	9.1							
			10.2	(10.2)						

List of Negatively Consensual Statements with Factor Scores

		Scores	
11.1	Where large investments are involved, companies should have the right to review faculty appointments.	-4	-5
4.6	Free and open exchanges in science that threaten industrial leadership are justifiably controlled.	-3	-3

- |      |   |    |    |
|------|---|----|----|
| 9.1  | Too much weight is given to the role of peer-reviewed journals in the process of scientific communication. Science doesn't not exist until it is published. | -2 | -2 |
| 10.2 | Policy concerning university-industry relations should be set and resolved at the department level.   | -1 | -2 |

Discussion of Negatively Consensual Card Distribution

On the whole, these statements do nothing to contradict the themes drawn from the positively consensual items. The implicit issues of encroachment and boundary crop up again. Specifically, it is up to faculty, not business operatives, to determine access to academic membership and information (11.1, 4.6). Although the emphasis is weaker, quality control (9.1) is also an exclusively academic matter. These exigent statements send off caution signals like a blinking yellow light. They attempt to firm up lines. They also "feel" defensive, thrown up as roadblocks to prevent something undesirable from occurring.

Now that we have observed what the factors share in common, attention shifts to the meanings contained in the context of the 24 statements which discriminate most between factors (Table 5.9, p. 86). Card codes bracketed within parentheses signify factor A historians.

Discussion of Meaningfully Differentiated Statements

Observe that all but two of factor A's (historians) scores are found to the left of the zero cell. And only three statements (4.8, 6.3, 9.7) are shown to have earned high positive or negative scores. Conversely, only one factor B (polymer scientists and engineers) score displays even a slight negative valence. Polymer scientists, moreover, allocated fifteen (15) statements to the +5 cell. The relative location of statements suggests that factor A historians regard the subject

Table 5.9

Distribution of Statement Items with Score Differentials  
of 4 or More by Factor  
(Factor A Historians in Parenths)

Most Unlike											Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5		
				(2.5)								2.5
		(2.9)					2.9					
					(2.10)							2.10
				(2.11)					2.11			
				(2.14)								2.14
						(3.2)						3.2
				(3.5)								3.5
			(3.10)						3.10			
				(3.11)								3.11
			(3.14)						3.14			
			(3.16)						3.16			
		(4.2)					4.2					
			(4.4)									4.4
			(4.7)									4.7
(4.8)												4.8
			(4.10)									4.10
			(4.15)									4.15
		(5.4)										5.4
					(5.11)							5.11
			(6.2)									6.2
(6.3)						6.3						
	(7.1)											7.1
				9.7							(9.7)	

matter configured here far less enthusiastically than their factor B counterparts. This statement map is also significant because of what is absent. It would appear that historians and scientists have no fundamental disagreement over the Traditionalist values featured in category 1 (the university as a non-market phenomenon) statements.

It might help to simplify the interpretive process once again by focusing on each major subject category in Table 5.9 (the university as an economic entity, disinterestedness/autonomy, the treatment of intellectual property) in turn.



Table 5.10

Distribution of Category 2 (the university as an economic entity) Statements by Factors (Historians in parens)

Most Unlike										Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	
				(2.5)						2.5	
		(2.9)					2.9				
					(2.10)					2.10	
				(2.11)				2.11			
				(2.14)						2.14	

Listing of Category 2 Statements with Factor Scores

		Scores	
		A	B
2.5	The claims made by critics of university-industry ties exaggerate the negative impacts and neglect the reciprocal benefits to both institutions.	-1	+5
2.9	The scientific process is essentially self-correcting, and more research money, not management, is all that is needed to rectify abuses of the past.	-3	+2
2.10	More industrial support induces wider scientific participation, which in turn elevates the level of cross-collaboration, which is what ultimately moves science ahead.	0	+5
2.11	The effects of industry funding of universities are no different from those of government funding.	-1	+3
2.14	A more applied orientation will be good for American university science, reducing the academic isolation that developed during earlier postwar periods.	-1	+5

Discussion of Category 2 Statement Distribution

The distribution of category 2 statements suggests that factor A historians and factor B polymer scientists/engineers are at odds over the implications of industry funding of academic science. Historians in this case seem to perceive corporate support as different (2.11), vaguely foreign and possibly harmful (2.5). This orientation begins to

explain the hedging by historians alluded to earlier in Table 5.6.

Perhaps motivated by more utilitarian concerns (2.14), factor B polymer scientists/engineers view the issue of corporate funding in a more optimistic light (2.5, 2.10, 2.11). In the collective eye of factor B scientists, the benefits of industry/university collaboration appear to outweigh the drawbacks (2.5). Industry money really does not pose any new concerns (2.11). Indeed, these arrangements foster and promote intellectual cross-fertilization (2.10) while enlarging the role of university science (2.14).

Perhaps most revealing, for the first time we are briefly exposed to different thinking about scientific epistemology. Does the enthusiasm evinced by polymer scientists stem from a belief in a socially neutral, essentialist science (2.9)? If this is the case, why worry about the university's alliances if scientific processes are self-adjusting (2.9)? By extension, evidently factor A historians don't share this optimistic idea of contextual isolation, but rather deem scientific action as culturally vulnerable. Perhaps historians hesitate because they believe traditions to be fragile.

Table 5.11

Distribution of Category 3 (academic disinterestedness)  
Statements by Factor (Factor A historians in parens)

---

Most Like												Most Unlike	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5			
						(3.2)						3.2	
			(3.5)									3.5	
			(3.10)					3.10					
				(3.11)								3.11	
			(3.14)					3.14					
			(3.16)					3.16					

---

### Listing of Category 3 Statements with Factor Scores

	Scores	
	A	B
3.2 Limits should be placed on how much time faculty can devote to outside concerns. The one-fifth rule allowing one day per week is fair and adequate.	+1	+5
3.5 Conflicts of interest can be minimized or avoided altogether by vigilance and good faith.	-1	+5
3.10 Universities are very much aware of complex issues like conflict of interest involved in technology-transfer activities and are dealing with them.	-2	+3
3.11 As long as I don't have controlling interest in a company, my personal financial information is a private affair, irrelevant to my research.	-1	+5
3.14 It's a shame that the whole issue of disclosure and divestiture is based on the assumption that financial rewards affect a researcher's work.	-2	+3
3.16 There is nothing improper with companies paying for trips to scientific meetings and paying university scientists to talk at those meetings about topics related to the company's products.	-2	+3

### Discussion of Category 3 Statement Distribution

The historians and polymer scientists/engineers comprising factors A and B apparently maintain different viewpoints of what it is to be "disinterested." "Disinterestedness" or intellectual autonomy is defined in the Traditionalist (Mertonian) sense as intellectual work that is free of any extraneous obligation. Scientific interest serves no other master, but is ideally motivated for its own sake (Richards, 1987). Breaches of this alleged institutional neutrality constitute conflicts of interest.

The six statements in dispute here seem to imply that historians and polymer scientists/engineers define conflicted interest differently. Factor A historians, for example, appear to believe that conflicts of

interest should receive more serious consideration (3.5, 3.10). Hopeful expressions of good faith and the enforcement of "one fifth" rules are in themselves not enough to insure the intellectual freedom of academic work. Academicians possess no special immunity from "external" influences (3.14). There is an unspoken suggestion that stricter definitions and enforcements are in order.

Factor B polymer scientists/engineers, on the other hand, apparently reduce the issue to the level of individual probity (3.5, 3.14). Conflicts of interest stem from a class of individual conduct rather than a structural one. If one is aware of the pitfalls and practices in good faith, conflict of interest should not be a concern (3.5). As a result, the polymer scientist treads where the historian fears to go (3.14). For example, one's personal finances, relationships with industry and honorarium should not be problematic for the sophisticated scientist (3.11, 3.16). Perhaps this confidence may be attributed again to a particular definition of science as a cognitive dimension safely removed from the everyday importunities and compromises endemic to the "outside" world. It follows, then, that, excepting traditional safeguards (3.2), no need exists for outside meddling in the private affairs of individual scientists (3.5, 3.10, 3.11). In the end, the definition of conflicted interests is properly left to the discretion of the individual scientist (3.11, 3.14, 3.16).

This interpretation implies that historians and scientists use different levels of analysis. It seems that historians prefer to interpret phenomena at the cultural/sociological level while polymer scientists emphasize the micro-analytic. Is social imperative or the heroic authority of the individual the ultimate locus of action? These



concerns readily translate into issues of power, of course. Sensitive to the expanding regulatory prerogative of outside agencies, is the scientist's principal concern to stake out inviolate territory? In the meantime, stymied by this conceptual inconsistency, a definition of conflicted interest goes begging. For example, do questions of conflict properly extend beyond curiosity/motivation to include project design, methodology and the overall direction of scientific activity?

Table 5.12

Distribution of Category 4 (Intellectual Property) Statements by Factor (Factor A historians in parens)

Most Unlike									Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
		(4.2)					4.2			
			(4.4)							4.4
			(4.7)							4.7
	(4.8)									4.8
			(4.10)							4.10
			(4.15)						4.15	

Listing of Category 4 Statements with Factor Scores

Statement ID	Statement Text	Scores	
		A	B
4.2	Some infringements of the university's principle of free dissemination of information should be allowed on a case by case basis in order to protect the university's financial interest.	-3	+2
4.4	Modest changes in university rules regarding intellectual property will allow commercial activities to go forward without threatening traditional values.	-2	+5
4.7	In expensive, large-scale university-corporate research partnerships, faculty should be required to sign confidentiality statements in which they agree not to disclose proprietary information.	-2	+5

- 4.8 Given industry's heavy investment in areas of university research, I see nothing wrong with submitting manuscripts to the company for review prior to submission to a journal. -4 +5
- 4.10 In order to protect worldwide commercialization rights for new technologies, it's perfectly acceptable for universities to ask their scientists to delay publication of their research findings to allow time for patents to be filed. -2 +5
- 4.15 While commercial interests sometimes stand in the way of full disclosure of scientific results, this impediment is more than compensated for by the infusion of additional funds which accelerates research thus increases the amount of scientific knowledge. -2 +5

#### Discussion of Category 4 Statement Distribution

Both the Instrumentalist and Traditionalist schools subscribe to the conviction that scientific custom and community depend on proper communication. Science is first and last an unrestricted dialogue or "cross-fertilization of ideas" (Mulkey, 1979). In short, the free sharing of ideas entails an ethics balanced against certain threats and risks. The ultimate threat against scientific reciprocity (and the generation of new ideas) being, of course, non-circulation or secrecy.

The Traditionalist in particular abides no deviation from altruistic norms. It comes as somewhat of a surprise, then, that factor A historians invest so little energy (excepting statement 4.8) into this sensitive issue. Perhaps, as found earlier, low scores indicate that this group of historians, at any rate, work in an arena largely unaffected by pressures to accommodate other interests. The card sorts

suggest that historians and polymer scientists work in distinct contexts.

The polymer scientists' enthusiastic endorsement of the Instrumentalist values captured in these six statements possibly reflects the special conditions of contemporary polymer research. It seems that factor B polymer scientists consider the ideal of open research a contingent concept (4.4, 4.7, 4.8, 4.10, 4.15). Perhaps this reflects a utilitarian attitude marking an accommodation to get a job done. Such a pragmatic orientation would not be considered unusual in technological sciences such as polymer science, agriculture, medicine and engineering. Practices like submitting manuscripts for review by sponsoring companies (4.8), delaying publication to allow time for patent filing (4.10), and signing confidentiality agreements (4.7) also concern academic authority, autonomy, and motivation - who and what is the scientist working for (audience, motives), and who determines scientific merit and how is this judgment to be made? Do these "violations" of the cosmopolitan ethos of pure science confirm polymer science as applied? Under these circumstances, is the pure science vs. applied science debate relevant any more? We are beginning to see how social definitions of boundaries work.

Attention now turns to the remaining (miscellaneous) statements which differentiate historians and polymer scientists. These statements are displayed in Table 5.13 (p. 95).

Table 5.13

Distribution of Miscellaneous Statements by Factor  
(Factor A historians in parens)

Most Unlike										Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	
		(5.4)							5.4		
					(5.11)					5.11	
			(6.2)							6.2	
(6.3)						6.3					
		(7.1)								7.1	
				9.7					(9.7)		

Listing of Miscellaneous Statements with Factor Scores

	Scores	
	A	B
5.4 Every university should be able to catalog the expertise of its members and then market those talents for fees or grants from corporations or other clientele.	-3	+4
5.11 There's nothing inappropriate for academic scientists, while holding regular academic appointments, to be proprietors, exclusively or jointly, in private business firms in which scientific knowledge gained in their academic capacity is to be used.	0	+5
6.2 It does not make any difference if the private sector replaces or complements government as the patron of science so long as the professional reward system of academe is preserved.	-2	+5
6.3 All professors should be obliged to develop revenue-generating projects as part of their responsibility. A professor's ability to generate funds should be one of the conditions of tenure.	-4	+1
7.1 The legal safeguards built into large corporate-university contracts plus procedural limits established by the university are more than adequate to protect the institutional autonomy of the academic scientific community.	-3	+5
9.7 Corporate sponsorship should be subject to peer review.	+4	-1



### Discussion of Miscellaneous Statement Distribution

While the final six statements are too few to probe much beneath the surface of any particular category (entrepreneurism, 5.4, 5.11; career reward structure, 6.2, 6.3; project design, 7.1; and quality control, 9.7), they provide useful examples of the tensions dividing Traditionalists and Instrumentalists. For example, statement 5.4 refers to the overall social purpose of research universities. The Traditionalist asks whether faculty can realistically be academics and businessmen at the same time without neglecting vital educational and dialogic duties. Statement 5.4 also hints of a (Traditionalist) concern about the extension of the price-system into hitherto protected areas of the university. The commodification of knowledge that this purportedly facilitates will see the university's traditional social forms supplanted by economic instrumentality. Polymer scientists manifest more enthusiasm than historians (5.4 and 5.11); university-industry contracts, after all, have built-in safeguards (7.1) negating the need for peer oversight of such agreements (9.7).

Historians, once again, are more difficult to read. They reject strategies to market university talent (5.4) but are completely indifferent to university scientists commercially exploiting the fruit of their academic research (5.11). Perhaps historians find this last issue too remote. Not surprisingly, perhaps, historians are clearly unhappy with statement 6.3 and have less faith in good faith legal arrangements with industry. Perhaps these opposing reactions stem once again from two different "takes" on these issues - one (historians) cultural and moral; the other (polymer scientists) legal.

This chapter closes with an analysis of those statements which most sharply discriminate the composite points of view represented by factors A and B.

Table 5.14

Distribution of Statements Most Sharply Discriminative  
(cells -5, -4, and +5, +4) for Factor A (Historians)

---

Most Unlike										Most Like		
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5		
2.6	3.9								3.6	4.9		
	4.8								9.7	8.3		
	6.3									11.2		
	11.1											

---

Listing of Negatively Scored Statements

- 2.6 Universities exist mainly to help industry turn knowledge into technology, technology into productivity, and productivity into profit. Cell (-5)
- 3.9 Scientists who review other scientists' work for federal research agencies or for scientific journals have no obligation to reveal whether they have a financial stake in the research they are reviewing. (-4)
- 4.8 Given industry's heavy investment in some areas of university research, I see nothing wrong with submitting manuscripts to the company for review prior to submission to a journal. (-4)
- 6.3 All professors should be obliged to develop revenue-generating projects as part of their responsibility. A professor's ability to generate funds should be one of the conditions of tenure. (-4)
- 11.1 Where large investments are involved, companies should have the right to review faculty appointments. (-4)

Listing of Positively Scored Statements

- 4.9 A few heavily endowed industrial projects can distort the values and mission of the university. Industrial projects bring with them a new kind of scientific culture that rewards marketable research and protects proprietary information. (+5)

- 8.3 Market forces have always been a part of the shifts among posts in U.S. academia, but now the scale has dramatically altered their significance. These changes have created rifts within the faculties of each institution; the humanities and social science faculties often feel that they are being neglected. (+5)
- 11.2 The availability of industrial funding encourages hiring in specific areas, which may not match education's long-term priorities. (+5)
- 3.6 The pattern of collaboration between large universities and large corporations may be a familiar one. But the implications for the use of taxpayers' funds and the danger of conflicts of interest that these agreements raise require renewed evaluation. (+4)
- 9.7 Corporate sponsorship should be subject to peer review. (+4)

#### Discussion of Discriminating Statements for Factor A

Many of these statements constitute familiar ground, so there is no need to perform a statement by statement analysis at this point. Certain major themes need to be elaborated, however. A survey of statements makes clear that while factor A historians rarely slot opinions at the extremes, they are, nonetheless, consistent. Negatively scored statements are consistent and support positively scored ones and vice versa. Without exception, all of the statements shown above, on either side of zero, represent Traditionalist values. Positively scored statements manifest a patent distrust of new corporate/university partnerships. Nothing good will come from the pursuit of such alliances - a maldistribution of funds will raise interdisciplinary tensions (8.3), the conventional norms of scholarship will be undermined (4.9), the university's long-term interests may become a victim of the exigencies of the quarterly balance sheet (11.2), and such alliances throw the public purpose of the university into question not to mention that of faculty (3.5). The implications of these new alliances need to be reviewed by faculty (3.6, 9.7). Negatively scored statements

reinforce this anti-business orientation. Universities do not exist to turn a profit. Scholars run the risk of being recycled into entrepreneurs (6.3) if not corporate employees (4.8, 11.1). Added together, it is possible to detect a perception on the part of historians that events are outpacing faculty obligations and control (3.9, 4.8, 11.1, 4.9, 8.3).

Table 5.15

Distribution of Statements Most Sharply Discriminative  
(cells -5, -4, and +5, +4) for Factor B (Polymer Scientists)

---

Most Unlike									Most Like	
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
11.1									1.9	1.3
									2.3	2.5
									3.12	2.10
									4.15	2.14
									5.4	3.2
									7.2	3.5
										3.11
										3.15
										4.4
										4.7
										4.8
										4.10
										5.5
										5.7
										5.11
										6.2
										7.1
										8.3

---

Listing of Positively Scored Statements

- 1.3 Universities are not charged to ensure the worldly success of outside institutions, nor to uphold any values other than the sharing and improvement of ideas. Cell (+5)
- 2.5 The claims made by critics of university-industry ties exaggerate the negative impacts and neglect the reciprocal benefits to both institutions. (+5)



- 2.10 More industrial support induces wider scientific participation, which in turn elevates the level of cross-collaboration, which is what ultimately moves science ahead. (+5)
- 2.14 A more applied orientation will be good for American university science, reducing the academic isolation that developed during earlier postwar periods. (+5)
- 3.2 Limits should be placed on how much time faculty can devote to outside concerns. The one fifth rule allowing one day per week is fair and adequate. (+5)
- 3.5 Conflicts of interest can be minimized or avoided altogether by vigilance and good faith. (+5)
- 3.11 As long as I don't have controlling interest in a company, my personal financial information is a private affair, irrelevant to my research. (+5)
- 3.15 It is not proper to use graduate students to work on research a faculty member does for her firm. (+5)
- 4.4 Modest changes in university rules regarding intellectual property will allow commercial activities to go forward without threatening traditional values. (+5)
- 4.7 In expensive, large-scale university-corporate research partnerships, faculty should be required to sign confidentiality statements in which they agree not to disclose proprietary information. (+5)
- 4.8 Given industry's heavy investment in some areas of university research, I see nothing wrong with submitting manuscripts to the company for review prior to submission to a journal. (+5)
- 4.10 In order to protect worldwide commercialization rights for new technologies, it's perfectly acceptable for universities to ask their scientists to delay publication of their research findings to allow time for patents to be filed. (+5)
- 5.5 The social structure of science changes dramatically after discoveries become inventions and researchers entrepreneurs. (+5)
- 5.7 If you make the ethics of academic science the same as Wall Street, you're going to corrupt science. (+5)
- 5.11 There's nothing inappropriate for academic scientists, while holding regular academic appointments, to be proprietors, exclusively or jointly, in private business firms in which scientific knowledge gained in their academic capacity is to be used. (+5)

- 6.2 It does not make any difference if the private sector replaces or complements government as the patron of science as long as the professional reward system of academe is preserved. (+5)
- 7.1 The legal safeguards built into large corporate-university contracts plus procedural limits established by the university are more than adequate to protect the institutional autonomy of the academic scientific community. (+5)
- 8.3 Market forces have always been a part of the shifts among posts in U.S. academia, but now the scale has dramatically altered their significance. These changes have created rifts within the faculties of each institution; the humanities and social science faculties often feel that they are being neglected. (+5)
- 1.9 I have some confidence that the bottom line of projects will keep corporations from continuing to invest in activities that are not good for them. I have less confidence that academia has as clear a yardstick to judge the merits of various arrangements for its own integrity. (+4)
- 2.3 Continued links between the university and industry will legitimate the university to interests outside the university on the grounds of its contributions to the economic development of society. (+4)
- 3.12 Universities should also be worried about "conflicts of commitment" - situations where faculty members neglect their academic duties in favor of pursuing other activities, such as consulting outside the university. (+4)
- 4.15 While commercial interests sometimes stand in the way of full disclosure of scientific results, this impediment is more than compensated for by the infusion of additional funds which accelerates research and thus increases the amount of scientific knowledge. (+4)
- 5.4 Every university should be able to catalog the expertise of its members and then market those talents for fees or grants from corporations or other clientele. (+4)
- 7.2 With industrial support, there is relatively less freedom for the researcher because there is now a single line to follow, the line of the generous benefactor. (+4)

#### Discussion of Discriminating Statements for Factor B

Obviously, the polymer scientist/engineers have modeled a composite Q-sort highly skewed at the positive extreme.<sup>5</sup> Only one statement (11.1) is found at the negative ("Most Unlike") extreme. Not

much space will be devoted to 11.1 except to comment that its singular location may represent the last straw for polymer scientists. In other words, control over the appointment of colleagues is not to be shared with business colleagues. Perhaps statement 11.1 embodies a dimension where even polymer scientists draw unambiguous lines:

11.1 Where large investments are involved, companies should have the right to review faculty appointments.

Again, because we have dealt earlier with virtually all of the statements located in cells +4 and +5, there is no need for detailed discussion. However, some identifying polymer themes deserve special recognition. For example, eight (1.9, 3.12, 7.2, 1.3, 3.15, 5.5, 5.7, 8.3) or one third of the twenty-four statements in cells +4 and +5 validate Traditionalist values. If the pattern of statement placement in factor A suggests that historians are cool and consistent; the pattern in factor B favors an interpretation of polymer scientists as enthusiastic but inconsistent. How do we square, for example, strict Traditionalist statements typified by 1.9, 1.3 and 5.7 with the utilitarian sentiments expressed in 2.3 and 5.4; or statement 3.12 with Instrumentalist statements 3.11 and 5.11; or the opposition between 6.2 and 8.3? The fascinating thing is that this sample of polymer scientists is apparently comfortable with this mix of apparently irreconcilable values. Perhaps this indicates that polymer scientists, unlike historians, function within at least two normative worlds?

Polymer scientists are consistently pragmatic concerning the treatment of intellectual property; that is, it is conditionally free. The ideal of open scientific communication notwithstanding, all circumstances are not the same (4.4). There are instances, for example,



where confidentiality (4.7), contractual arrangements (4.8) and competitive realities (4.10) have to be accounted for. These exceptions should not be construed as system threatening, however (3.2, 7.1). On the whole, the benefits of industry-university collaborations more than compensate for any conceivable drawbacks (2.3, 2.5, 2.10, 4.15). Moreover, these arrangements are not qualitatively different from government contracts (6.2).

Besides, it's past time for the university to emerge from its self-isolation (2.3, 2.14). When irregularities happen (e.g., conflicts of interest) they are properly dealt with at the individual level (3.5). In general, the basic structure of the university and science continues on as before. In addition, the subjects in factor B adhere to the view that one's professional (inside the university) and private (outside the university) lives are separate and distinct (3.11, 5.11). Perhaps these suppositions preview examples of the kind of rhetoric necessary for coming to terms with the competing values above.

### Summary and Discussion of Factor Results

#### Factor A Historians - Closet Traditionalists?

Recall again the reason for employing a non-probabilistic (qualitative) subject sampling process. Absent any documented connection with the business community, historians were given the role of Traditionalist control group - i.e., the keepers of the university's ontological core. At the same time, as full-members of a technological science heavily reliant on industry support, the polymer scientist sample was deemed to represent a reasonable Instrumentalist proxy. Hypothetically, it was the polymer cohort's task to Q-sort the



academy's interactive frontier. At the outset of this research, in other words, each faculty set was expected to more or less faithfully rehearse the concentric schemas characterizing the Traditionalist/Instrumentalist and organizational literatures.

It turns out, however, that both samples produced a mild surprise. As expected, historians "correctly" confirmed the Traditionalist ethos while rejecting Instrumentalist values. This was illustrated in Table 5.5 (Distribution of Non-Economic and Economic Statements for Factor A). But, overall, these endorsements (unlike the Orwellian rhetoric featured in the Traditionalist literature) were made with little evident enthusiasm, i.e., factor A historians placed very few Traditionalist statements in the extreme cells. This fact makes it difficult to identify where this particular group of historians stands - their bottom line, so to speak. Historians do in fact draw some lines in indelible ink as we saw, for example, in Table 5.9 (Distribution of Factor Discriminatory Statements). However, the paucity of statements at the extremes seems to signal a general lack of conviction.

The Traditionalist literature's xenophobic tendencies spring from the conviction that the academy stands to lose far more than it gains in partnership with industry. For reasons that beg explanation at this point, our historians appear content to cheer from the sidelines. (Individual Q sorts provide a clue; i.e., several historians placed high numbers of card statements in the low value cells of -1, 0, +1. This seemed to parallel post-sort comments offered by some history faculty that many of the statement issues were new or immaterial.)

## Instrumentalists - "Eating Your Cake and ..."?

Polymer scientist boundaries did not materialize as predicted either. For their part, the sample of polymer scientists complicate matters by demonstrating a propensity for eating their cake and having it, too. Unlike Factor A historians, Factor B polymer subjects are highly opinionated. However, while the polymer card placements point to an Instrumentalist bias, polymer opinion is virtually split between Traditionalist (category 1 - Mertonian norms) and Instrumentalist (category 2 - utilitarian norms) statements (see Table 5.6 - Distribution of Non-Economic and Economic Statements for Factor B). We find that polymer sorting results contain apparent contradictions.

The Mertonian prescription for open intellectual exchange is a relevant case in point. Our scientist sample categorically endorse the Mertonian imperative of open intellectual exchange as shown in statement 1.3:

Universities are not charged to ensure the worldly success of outside institutions, nor to uphold any values other than the sharing and improvement of ideas. X

Yet, within the same breath (sort) they proceed to interject a long list of provisos such as those incorporated in statement 4.2; for example:

Some infringements of the university's principle of free dissemination of information should be allowed on a case by case basis in order to protect the university's financial interest.

or 4.4:

Modest changes in university rules regarding intellectual property will allow commercial activities to go forward without threatening traditional values. (See also statements 4.7, 4.8, 4.10, and 4.15.)

The roughly equal dispersion between themes from categories 1 and 2 appears to highlight an important work-related contradiction. At least in the case of our polymer scientist sample, this and other similar findings suggests a possible gap between abstract and practical line drawing. Polymer scientists coexist in two worlds - the market and the academy. In the process, they have learned how to accommodate to both. "Reconciliations" typified in the oxymoron of "limited secrecy" presented here (see also Etzkowitz, 1983, 1989) hint at the creative nature of organizational boundary making.

### Discussion

Factor A historians draw straight lines dividing acceptable norms from unacceptable ones. As expected, their lines enclose the nuclear academic ideals of the Mertonian catechism - disinterestedness, openness, etc. Yet, their cartography is so faint that interpretation is obscured. Factor B scientists, on the other hand, seem to have accommodated to two sets of contradictory lines, one Mertonian (espoused theory?), the other pragmatic (theory-in-use?) (Argyris & Schon, 1978).

By comparison, because of the sectarian nature of the Traditionalist/Instrumentalist discourse, lines are never in doubt. The pure Traditionalist, as we have seen, espouses a closed logical text predicated on a system of boundaries and inner constraints handed down more or less intact from generation to generation. Recognizable boundaries are essential if academic society is not to lose its special mission and character. The pure Instrumentalist envisions a more open, back-scratching arrangement with government and industry. Instrumentalist borders, consequently, resemble picket fences; nonetheless,

university boundaries are still real, still locatable. In step with organizational theory, neither of these traditions doubt that boundaries can be pinned down.

That our faculty findings fail to substantiate objective boundary of any kind is key, however. That is, by problematizing (blunting) the taken-for-granted sharpness of conventional notions of demarcation, faculty may have empirically revealed the pragmatic and therefore continuous nature of organizational "boundary." For historians, it appears that social boundary eludes straightforward definition. Sorting in undertones and soft hues, their definition of boundary remains amorphous, undeclared. By the same token, precise translation of polymer scientist boundary is lost in self-contradiction. Products of the tension between principles and practice, polymer boundaries appear improvised. The diffuseness of these empirical findings echoes the dynamic aspect of boundary typical of the interpretive literature. Of more theoretical significance, however, this finding of incoherence problematizes the ontological adequacy of the literature's regnant nomenclature of enclosure.

#### End Notes

1. In this case factor loadings equal to or in excess of 2.58 (SE) = 0.32 are significant at the 0.01 level. The standard error is given by the expression  $SE = 1/\sqrt{N}$  where  $N$  = the number of statements ( $1/\sqrt{66}$ ). At minimum, a factor should demonstrate at least two significant loadings or be excluded from further mathematical analysis (see Brown, 1980, pp. 221-223 for more detail).

In addition to the eight factor solution a factor analysis forcing the extraction of only two factors was carried out. Results were very similar to the "natural" eight factor solution particularly in terms of how faculty from both departments were aligned on the two major factors. In the heuristic spirit of Q Methodology, it was decided to focus on the natural occurring factors A and B. (The results of the two factor solution are found in Appendix C.)



2. Statement Codes for Tables 5.3 & 5.4: 1. Universities as non-economic institutions (Strict Traditionalist); 2. Universities as economic institutions (Strict Instrumentalist); 3. Disinterestedness (academic autonomy/neutrality); 4. The social relations of intellectual property; 5. Faculty entrepreneurship; 6. Faculty reward structure - what gets recognized; 7. Who shapes the design of work; 8. The Academy as collectivity; 9. Quality control (peer review/how discovery is ratified); 10. the Organization of work (departmental authority); 11. Criteria for faculty recruitment and advancement.
3. The lopsided number of statements in the +5 cell was somewhat of a surprise because on average polymer subjects placed no more than four cards in cell +5 (one subject placed seven statements in the +5 cell). Although perhaps unusual this asymmetric distribution occurred in this case for two reasons. One obvious explanation is that these particular cards were sorted into the +5 cell with high frequency. But it must be recalled that all Q sorts are not statistically equal. Some Q sorts, that is, load more heavily and therefore are closer approximations to a factor than others. As a result, they carry more "factor weight" (Brown, 1980). In other words, the unusual size of the +5 cell can be attributed largely to the extraordinary pull exerted by the heavy factor weights of high "loaders."
4. Item scores were found to be significantly different (statistically) between factors if they differed by two or more. For example, if the factor array scores for an item were identical or only apart by one, then the item scores the same for both factors. However, meaningfully different scores were considered conservatively - to be a difference of four or more. For mathematical detail about how to statistically distinguish factor scoring, see Brown, 1980, pp. 244-246.
5. Factor weight is given as  $w = f/1-f^2$ , where  $f$  represents the factor loading and  $w$  the weight. Weight derives from a subject's factor loading which reflects the fact that some Q sorts are closer approximations of a factor than others. For example, the factor weight ( $w$ ) for female subject H12 is  $.867/1-.867^2$  or 3.47. Whereas, H11's factor weight works out to be only 0.91. H11's Q sort, in other words, carries only  $(.91/3.47)$  or 26 percent of the weight of H12's Q sort for calculating factor scores - the basis for defining factor A's composite opinion. (See Brown, 1980, pp. 241-242 for details.)

## CHAPTER 6

### CONCLUSIONS WITHOUT CONCLUSIONS

*Categoriality is not simply another category, but the ground for all categories, i.e., that which renders categories possible. Cognitive-affective, real-symbolic, objective-subjective, explanation-interpretation - all such establish rigid and often arbitrary boundaries, encourage exaggerated oppositional thinking and sides-taking, and impose intellectual barriers to a more direct experiencing of and feeling for the organism. Each dichotomy therefore requires systematic deconstruction before the dialectic can proceed in the direction of a more fruitful synthesis.*

Brown, 1989

In the logic, if not the letter, of Burns and Stalker (1961), this research attempts to address whether organizational theory empirically "fits" the reality it claims to explain. In other words, does our theorizing adequately represent organizations as they really are? Accordingly, insofar as organizational boundaries frame the way we think about organizations, an attempt was made to empirically elucidate their ontological substance. Employing Q Methodology, select university faculty sorted a set of statements relating to the social relations of academic work. The "insubstantiality" of organizational borders elaborated in this study constitutes grounds for reflecting on the discipline's unspoken presuppositions regarding the "coherence, boundedness, and sharedness of cultural meaning systems" (Shore, 1991: 9).

#### Implications

The results of this study have potentially unsettling implications for functionalist theorizing. The question that this research raises for the literature is this - given the interdependence of phenomena and

organizations today, can organizational scholars continue to entertain a notion of organizations as "analytically distinctive social units" (Georgiou, 1973) disconnected from the general societal culture (Smircich, 1985; Calas & Smircich, 1987, 1988) and still claim relevance?

That is, as organizational action escapes our attempts to contain it, organizational analysis needs to shift from a near-exclusive absorption with locating social structures on the "inside" and begin to seriously address their elaboration within an interorganizational context (the "outside") (Pondy, 1977; Calas & McGuire, 1990; Clegg, 1990). If conventional analytic dichotomies such as external/internal or environment/organization (or Traditionalist/Instrumentalist) represent prime examples of "misplaced concreteness" (products of logic infused with an empirical existence) (Weick, 1977); and, moreover, if these binary categorizations are found to be increasingly out of touch with a cosmopolitan empirical reality, then epistemology emerges as the new focus of analytic concern (Weick, 1976, 1977; Manning, 1979; Smircich & Stubbart, 1985; Turner, 1990). Analysis, in short, properly shifts to how analysts and practitioners draw their lines.

After all is said and done, Traditionalists and Instrumentalists are both right and wrong at the same time. The Instrumentalist proposition that no sharp lines exist is a valid one - as far as it goes. But the Instrumentalist, I feel, misses the (Traditionalist) point. I would like to suggest that the Traditionalist promotes the preservation of an "ideal" university because, as these findings suggest, there are no sharp edges. That is, Traditionalists persist precisely because borders are vague and dynamic extensions of "the



incoherence of the academic structure" (Veysey, 1965: 442). For some at least, ambiguity is a poor defense against the erosion of academic independence and other signifying institutional values.

Let's take a moment to expand on the theoretical discussion developed in Chapter 2. Recall that we constructed an annulated model of organization in which the organization literature was partitioned into two concentric theoretical fields. For example, the model's outermost zone was described as functioning as a theoretical *cordon sanitaire* dampening any environmental force with the potential to overwhelm the organization's homologous identity. Pioneered in open systems and contingency theories, this setting represents the permeable negotiating arena where "fits" and equilibriums, subunit power, bargaining and influence, power struggles, loose coupling, new organizational designs, etc.- are pretested and enacted.

We saw also that all energy emanates from the model's climate-controlled command center (seen occupying the center of Figure 2.1). This core space enshrines the Classical genre's invariable macro-logic regarding managerial authority and organizational form (Graf, 1979; Miller & O'Leary, 1989). To maintain (i.e., to keep all other expression out) and possibly extend and consolidate its security and power (see Williamson, 1975), the core relies on the aura of objective, non-negotiable boundaries to deflect any potentially de-centering forces that penetrate the perimeter (see Figure 6.1.).

Shown from above (management's perspective), this concentric model illustrates the literature's ambivalence regarding the substantivity of organizational ontology. Analogous to the Traditionalist/Instrumentalist discourse, organizational theory waffles between a faith in



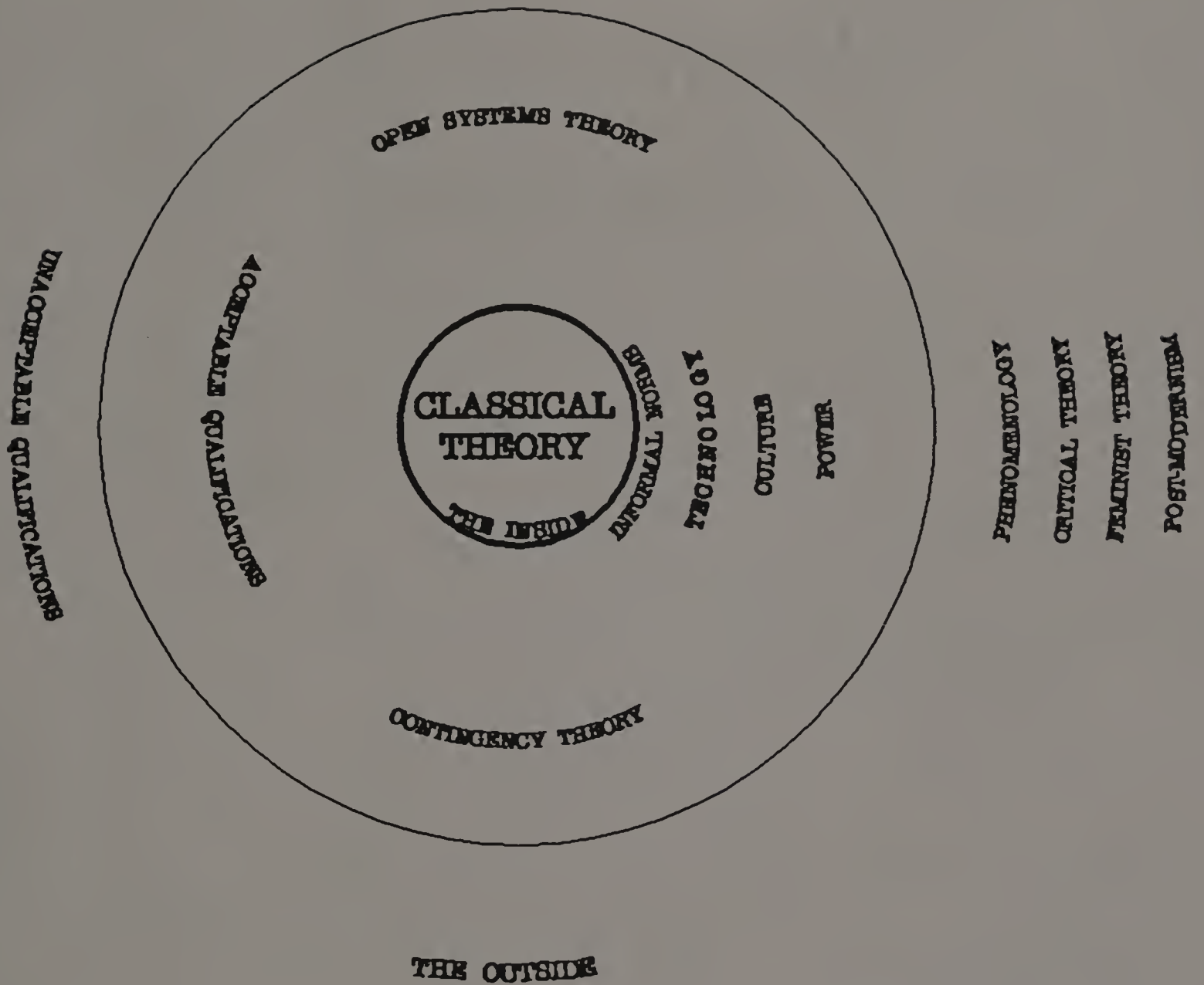


Figure 6.1. The Ins(ides) and Outs(ides) of Organizational Theory: A Topographical Schema

the "real," "substantive" constructs deployed by Classical theorists (the core) and the negotiable versions qualifying more recent theorizing (the borderlands). Parthasarthy and Sethi's (1992) article typifies this conceptual schizophrenia.

But from another angle we can see that not all ontology is equal. If we carefully turn the model on its side, we obtain a better picture of its distinctive ontological shape (see Figure 6.2.). In profile, the central core resembles a citadel granting those privileged enough to sit at the top a commanding vista of the surrounding environment. The citadel's stony physicality embodies what is lasting, good, prototypic. Conversely, everything lying outside the citadel's implacable identity - i.e., anything implying "impermanence, dissolvability, and tacitness" (Astley & Zajac, 1991) is routinely designated a dysfunctional anomaly or pathology. It is the hierarchic authority of this ontological monument that is at stake here. Boundaries, as these schema indicate, are not simply inert physical circumscriptions, but flexible constructs that define "how things ought to be, what is good and worthwhile" (Adams & Ingersoll, 1990).

The Traditionalist literature cautions that the constitution of a field of research as well as the content of inquiry and the treatment of results (distribution and validation) does not occur in a normative vacuum. "The management of science...has an ideological content, insofar as science is in itself a 'normative' activity" (Aronowitz, 1988). The more science is conceived as power (Aronowitz, 1988), the prospect is enhanced that compromises will be struck, allowing proprietary concerns (patents, copyrights, secrecy) to co-opt a

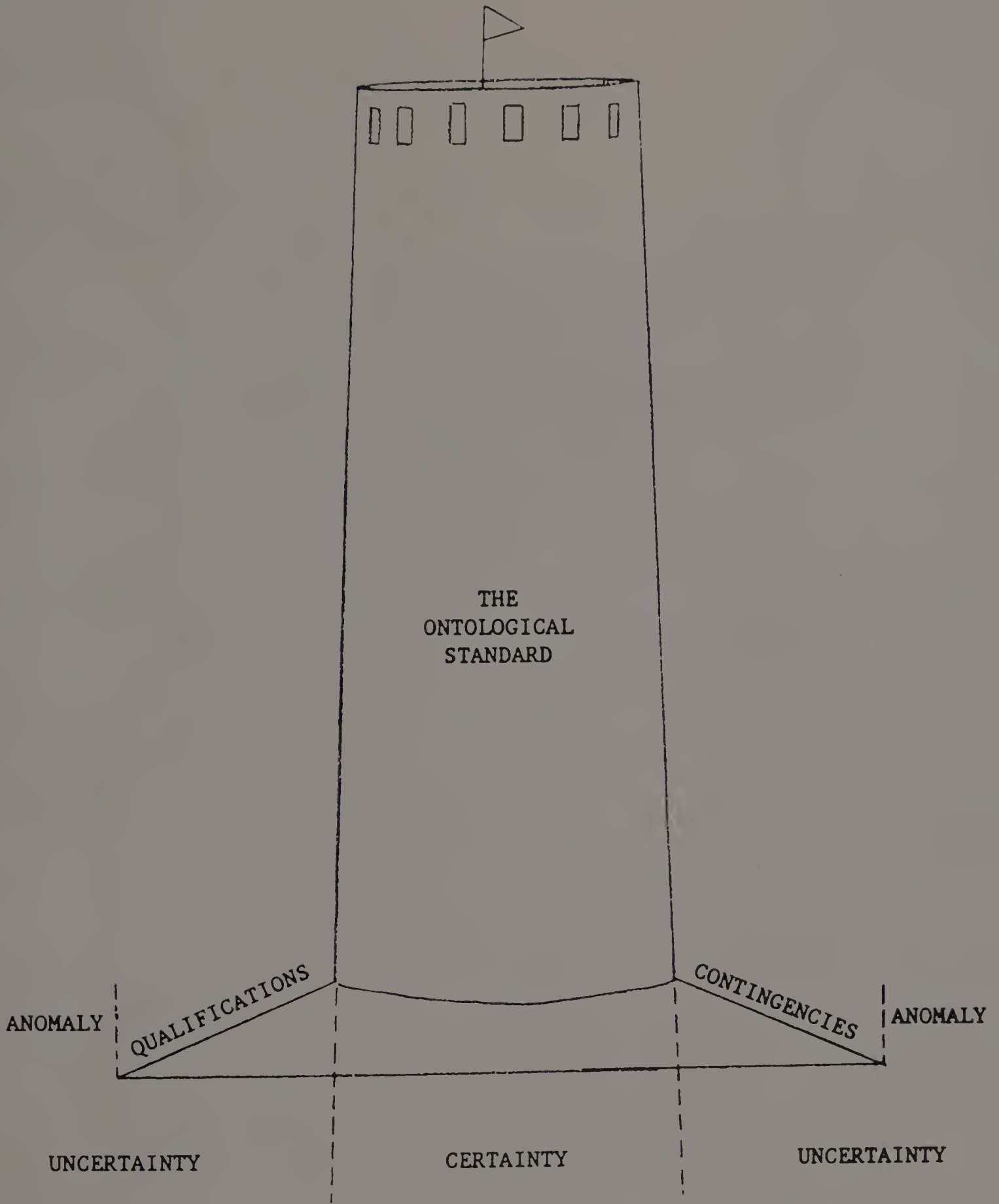


Figure 6.2. The Ontological Profile of the Organizational Literature

university culture predicated in principle on open debate, peer review and publication.

Arguably, the very structure of modern multi-universities made resistance unlikely. The specialization of curriculum and professionalization of faculty, hierarchic authority, as well as a "commercial compulsion" (Bledstein, 1976; Berry, 1985) to satisfy student/customers in a competitive effort to meet enrollment quotas have allegedly denied higher education any intellectual thematic coherence (Bledstein, 1976; Berry, 1985; Graff, 1985). The imperatives of career and speciality served to isolate faculty and students leaving the operational definition of universities in the hands of people most disposed to the praxis of the bottom line, i.e., the administration.

Bledstein (1976) adds that "In every modern nation, the educational system has represented goals embedded within the expectations of the culture" (309). That is, the structural arrangements between universities and their context to a large degree frame their definitions. Thus it happened that the occupational relations and pragmatic impulses of the multi-university increasingly corresponded with those operative in corporate culture. Like industry, the university experience came to stress means ("how to make") over ends ("how to judge") (Berry, 1985).

The "indeterminacy" of borders empirically elaborated in this study, then, opens the literature's core territorial assumptions (the citadel) to transgression and interpretation. If, in other words, the "thingness" (Weick, 1977) of borders can no longer be sustained unproblematically, how is the Archimedian point of the management science universe - the single-minded, factual "organization" - to be



located? Without firm boundaries, "insides" and "outsides" are no longer knowable. And "organizations" and "environments" dissolve into disorganized, deterritorialized "nonplaces" (Ashley, 1989). The general effect for theory is one of epistemic vertigo as we lose the ability to "position ourselves within this space and cognitively map it" (Stepanson & Jameson, 1988: 7).

The broad scale redrawing of institutional borders apparently underway today suggests that we reconsider interpretive grammar that promotes organizations as sovereign and unified "centre(s) of calculation and classification" (Clegg, 1990). The literature has acknowledged dimensionless artifacts like power, technology, and culture (although it still endeavors to calibrate them). Now the central theoretical issue is how to (re)think about organizations in a non-discrete world without slipping back into rationalistic and functionalist (i.e., territorialized) thinking? Perhaps a place to begin this reconceptualization is with the question, why is the literature in the "shape" it's in? What does the core mean? Why is it so central? Most importantly, what is closed to discussion (the real "outside") when theory is rooted in place(s)?

Organizations other than universities face comparable issues with regard to "deterritorialization" (Ashley & Walker, 1990). Computer-integrated manufacturing, global electronic capital transfers, ecological events, the multi-(supra)national corporation, etc. represent examples of "placeless" action. That is, to think of organizations in the exclusivist imagery validated in neo-classical theory (Perrow, 1986), and/or in the narrow micro-trading emphasis of transaction-costs economics (Williamson, 1975) is to grossly over-

simplify the symbiotic tapestry of contemporary interorganizational relations (Calas & McGuire, 1990). With or without the aid of formal theory, practitioners also need to contemplate the ecumenical (i.e., Barnardian) implications of these boundary transcendent phenomena.

### Limitations

From an interpretive perspective, this cross-sectional analysis only scratches the surface. There is the immediate business of following up on the present research (Brown, 1980). The interpretations derived here, for example, need to be verified with subject faculties. In-depth interviews might help us learn more about the reasons individual faculty and cohorts sorted as they did.

Other questions need to be explored. Our findings indicate that opinion divides along more than simply departmental lines. How, for example, do generation and gender, impact the sorting process? Pfeffer (1982) observes that academic gestalts are largely historical products of where and when graduate training occurs. An inter-generational design might provide a needed baseline to assess the penetration of market values over time.

Clearly, the opinions of women faculty need to be examined in more depth. The five female historians - the only women in the faculty sample - loaded virtually as a unit on Factor A. Is it with female faculty and other professional "minorities" where relatively pure, sharp-edged "Traditionalist" academic boundaries are to be found?

In addition, the size (31) of the faculty sample employed in this research limits extrapolation. Except for faculty with similar demographic profiles, we are not in a position to generalize about how

other academic and non-academic administrative and research personnel might factor. We need to cast our net farther if we are to develop a broader sense of the prevalence of marketplace thinking among different university constituencies.

Given the continuing interest of policy makers in the direction and content of industry-university relations (see Blumenthal, et al., 1986, 1986a; and the survey sponsored by the Office of Technology Assessment [OTA] [1984]), this study may be viewed as a preview as well as a pretest for a more encompassing research effort. The sample used here, therefore, should be expanded to include more "insiders" such as faculty from a more diverse selection of disciplines, students and university administrators; and "outsiders" such as industrial scientists and managers, federal grant administrators and state legislators. With some 3600 colleges and universities in this country, including 100 serious research schools (Radin, 1991), not to mention industry, there is no shortage of sites to chose from.

#### Contributions

Regarding method, this study suggests that Q can be an effective mechanism for clarifying the elements shaping normative border disputes. This largely stems from the proposition that Q provides a reliable means to probe sensitive issues via the anonymity inherent in the statement sorting process itself. Thus, Q offers a possible way around the self-reporting bias diminishing the value of other approaches particularly for red button items such as conflicts of interest or questions concerning institutional goals and identity (see Krinsky, Ennis, & Weissman [1991]). Q, for example, might have helped Brandeis faculty

and administrators to simplify the sometimes prickly "vortex of swirling perceptions" unleashed during the university's recent quest to redefine itself (Leatherman, 1990). Other applications for boundary-oriented research might include surveying physician opinion regarding the rationing of health care or the effects of physician joint ventures and other investment relationships with health care facilities.

Closer to home, Q might also clarify aspects of the Internalist (science is impervious to social context), Externalist (science is another social problem) debate once preoccupying the sociology of science (Barnes & Edge, 1982). Perhaps subjectivist theory has eclipsed Internalist theory in the minds of sociologists, but, as our findings seem to suggest, Internalism may live on in the laboratory. As in the case of the border dispute between Traditionalists and Instrumentalists, perhaps Q can aid us in developing a more nuanced understanding of how scientists reconcile working contradictions between theory and practice (Etzkowitz, 1983, 1989).

The value of this research is that it demonstrates the possibility of studying process as it cognitively happens. This is important for theory and practice because the concept of continuity changes everything. Boundarylessness, therefore, is not just a metaphor but a description of a reconstituting reality. Questions of control, heretofore so central to management and theory, - who defines, who determines - are non-questions - illusory. In the end, the citadel is actually a castle of sand because of the inverse relationship between interdependence and control. The real issue, then, is how do we reconcile ourselves with the fact that boundarylessness has become the norm? How, for example, will university officials compensate for recent



cancellations of state-supported economic-development research grants made to universities as recently as the mid-1980s (Blumenstyk, 1992)? How do those in the role of theorists model "organizations" swept up in the on-going process of interdependent reconfiguration?

APPENDIX A

SAMPLE SCORE SHEET FOR Q SORT

APPENDIX B

POPULATION (66) OF Q STATEMENTS BY TOPIC CATEGORY

SAMPLE SCORE SHEET FOR Q SORT

most  
uncharacteristic

most  
characteristic

	-4	-3	-2	-1	0	+1	+2	+3	+4
(2)									(2)
	(3)							(3)	
		(4)					(4)		
			(5)	(5)	(5)				

Sample Respondent Demographics

Age \_\_\_\_\_ Position: Assistant, Associate, Full Professor

Years of full-time academic teaching and research \_\_\_\_\_

Number of Publications \_\_\_\_\_

Number of Conference Presentations \_\_\_\_\_

Teach graduate students: Yes/No.

Number of research grants from:

Government agencies \_\_\_\_\_

Industry \_\_\_\_\_

Foundations \_\_\_\_\_

Other \_\_\_\_\_

On the average, how many days a year do you devote to consulting for industry and/or government? \_\_\_\_\_

How many of the following do you hold:

Patents \_\_\_\_\_

Copyrights \_\_\_\_\_

Have you ever:

Planned or actually formed a business venture based on your research? Yes/No.

Sat on any scientific advisory boards to industry? Yes/No.

Actively explored integrating your professional work with an existing company(ies)? Yes/No.

Participated in any joint research projects with industry? Yes/No.

Does your department have:

Staff from firms in private industry held non-salaried or salaried faculty appointments? Yes/No.

Staff from private industry offered courses for academic credit? Yes/No.

Members of your department left the university to form their own firms in order to commercialize the results of their research? Yes/No.

On average, what percentage of the graduate students trained in your department go on to take jobs in industry? \_\_\_\_\_



Population (66) of Q Statements by Topic Category

- (1) Universities as Non-Economic Institutions (Traditionalist)
- (1:1) Problem solving in service to industry is gradually eroding the norm of discipline education and bringing the academic in contact with groups outside the university who have little regard for autonomous reason and ethics.
- (1:2) Close links between the university and industry are merely the reflection within the research community of a broader strategy adopted by U.S. capital, namely its effort to tighten control over access to the results of scientific research.
- (1:3) Universities are not charged to ensure the worldly success of outside institutions, nor to uphold any values other than the sharing and improvement of ideas.
- (1:4) As the university budget squeeze continues, it becomes increasingly clear that the university cannot sustain both a broad liberal arts curriculum that emphasizes teaching of basic intellectual skills and values, and a commitment to competitive advanced research with commercial profit. Gradually the former is losing.
- (1:5) University officials maintain that they must pursue the path of commercial research in order to support their educational activities. In reality, they are sacrificing those educational activities in order to support their commercial ventures.
- (1:6) The question for the '90s is whether universities are to be public-sector institutions spending public money or private-sector institutions supported with public money.
- (1:7) It's always a mistake to reduce support for fundamental science in order to address things you think may have more immediate applications.
- (1:8) Both university and corporate participants presume incorrectly that their diverse interests can be easily harmonized, and that problems can be easily worked out.
- (1:9) I have some confidence that the bottom line of projects will keep corporations from continuing to invest in activities that are not good for them. I have less confidence that academia has as clear a yardstick to judge the merits of various arrangements for its own integrity.

- (1:10) The university, heretofore viewed by business as a source of training persons and expert advice, is now being looked at as a factor of production.
- (1:11) Expensive, well-publicized corporate/university partnerships are dangerous not only for the threats they pose to the traditions of academic science, but because other institutions will use these instances as "models" of the way university-industry agreements ought to be.
- (2) Universities as Economic Institutions (Instrumentalist)
- (2:2) The research university must assume a third function - economic development - in addition to the traditional ones of teaching and research.
- (2:3) Continued links between the university and industry will legitimate the university to interests outside the university on the grounds of its contributions to the economic development of society.
- (2:5) The claims made by critics of university-industry ties exaggerate the negative impacts and neglect the reciprocal benefits to both institutions.
- (2:6) Universities exist mainly to help industry turn knowledge into technology, technology into productivity, and productivity into profit.
- (2:9) The scientific process is essentially self-correcting, and more research money, not management, is all that is needed to rectify abuses of the past.
- (2:10) More industrial support induces wider scientific participation, which in turn elevates the level of cross-collaboration, which is what ultimately moves science ahead.
- (2:11) The effects of industry funding of universities are no different from those of government funding.
- (2:14) A more applied orientation will be good for American university science, reducing the academic isolation that developed during earlier postwar periods.
- (3) Disinterestedness (Academic Autonomy)
- (3:2) Limits should be placed on how much time faculty can devote to outside concerns. The one-fifth rule allowing one day per week is fair and adequate.

- (3:4) Scientists who shift their attention to the economic benefits of research or who hold equity in firms that market scientific discoveries cannot, at the same time, serve society as disinterested experts on the impacts of the new scientific technologies.
- (3:5) Conflicts of interest can be minimized or avoided altogether by vigilance and good faith.
- (3:6) The pattern of collaboration between large universities and large corporations may be a familiar one. But the implications for the use of taxpayers' funds and the danger of conflicts of interest that these agreements raise require renewed evaluation.
- (3:7) Congress should press for public disclosure of faculty members' extramural ties and for the release of the texts of corporate-sponsored research agreements at universities.
- (3:8) Researchers should pledge that while a study is in progress, they will not hold stock in the companies making or distributing the products being evaluated.
- (3:9) Scientists who review other scientists' work for federal research agencies or for scientific journals have no obligation to reveal whether they have a financial stake in the research they are reviewing.
- (3:10) Universities are very much aware of complex issues like conflict of interest involved in technology-transfer activities and are dealing with them.
- (3:11) As long as I don't have controlling interest in a company, my personal financial information is a private affair, irrelevant to my research.
- (3:12) Universities should also be worried about "conflicts of commitment" - situations where faculty members neglect their academic duties in favor of pursuing other activities, such as consulting outside the university.
- (3:13) The best way to handle the conflict of interest issue is for the government to delegate oversight to individual universities. Each can then design policies best suited for its faculty and mission.
- (3:14) It's a shame that the whole issue of disclosure and divestiture is based on the assumption that financial rewards affect a researcher's work.
- (3:15) It is not proper to use graduate students to work on research a faculty member does for her firm.



- (3:16) There is nothing improper with companies paying for trips to scientific meetings and paying university scientists to talk at those meetings about topics related to the company's products.
- (3:17) Faculty ought not to teach in areas where their commercial interests are direct and proprietary.
- (4) The Social Relations of Intellectual Property
- (4:1) The only "property rights" allowable for scientific discoveries are the scientific honors and rewards that derive from recognition of their originator.
- (4:2) Some infringements of the university's principle of free dissemination of information should be allowed on a case by case basis in order to protect the university's financial interest.
- (4:3) The unwillingness of academic researchers supported by industry to make research results public will slow the research process of colleagues.
- (4:4) Modest changes in university rules regarding intellectual property will allow commercial activities to go forward without threatening traditional values.
- (4:5) Science is nourished by free and open exchanges of information. There is no place for proprietary knowledge in the academy.
- (4:6) Free and open exchanges in science that threaten industrial leadership are justifiably controlled.
- (4:7) In expensive, large-scale university-corporate research partnerships, faculty should be required to sign confidentiality statements in which they agree not to disclose proprietary information.
- (4:8) Given industry's heavy investment in some areas of university research, I see nothing wrong with submitting manuscripts to the company for review prior to submission to a journal.
- (4:9) A few heavily endowed industrial projects can distort the values and mission of the university. Industrial projects bring with them a new kind of scientific culture that rewards marketable research and protects proprietary information.



(4:10) In order to protect worldwide commercialization rights for new technologies, it's perfectly acceptable for universities to ask their scientists to delay publication of their research findings to allow time for patents to be filed.

(4:15) While commercial interests sometimes stand in the way of full disclosure of scientific results, this impediment is more than compensated for by the infusion of additional funds which accelerates research and thus increases the amount of scientific knowledge.

(5) Faculty Entrepreneurism

(5:1) The norms of science abjure scientists from becoming directly involved in transforming their research results into objects of monetary value. Accordingly, academic scientists who market their research are defined as deviant.

(5:4) Every university should be able to catalog the expertise of its members and then market those talents for fees or grants from corporations or other clientele.

(5:5) The social structure of science changes dramatically after discoveries become inventions and researchers entrepreneurs.

(5:7) If you make the ethics of academic science the same as Wall Street, you're going to corrupt science.

(5:9) Two classes are being created within the academic profession: those who produce knowledge which can be made the basis of business enterprises, and those who do not.

(5:11) There's nothing inappropriate for academic scientists, while holding regular academic appointments, to be proprietors, exclusively or jointly, in private business firms in which scientific knowledge gained in their academic capacity is to be used.

(6) Faculty Reward Structure

(6:2) It does not make any difference if the private sector replaces or complements government as the patron of science as long as the professional reward system of academe is preserved.

(6:3) All professors should be obliged to develop revenue-generating projects as part of their responsibility. A professor's ability to generate funds should be one of the conditions of tenure.

(7) The Design of Academic Work

- (7:1) The legal safeguards built into large corporate-university contracts plus procedural limits established by the university are more than adequate to protect the institutional autonomy of the academic scientific community.
- (7:2) With industrial support, there is relatively less freedom for the researcher because there is now a single line to follow, the line of the generous benefactor.
- (7:4) Since industry rarely encourages fishing expeditions, the more industry funds research the less U.S. universities will nurture the capacity to innovate.

(8) The Academy as Community

- (8:3) Market forces have always been a part of the shifts among posts in U.S. academia, but now the scale has dramatically altered their significance. These changes have created rifts within the faculties of each institution; the humanities and social science faculties often feel that they are being neglected.
- (8:5) There are bound to be adverse consequences in terms of collaboration among faculty in various departments if one group must worry about protecting corporate rights to licenses.

(9) Quality Control (Peer Review)

- (9:1) Too much weight is given to the role of peer-reviewed journals in the process of scientific communication. Science doesn't not exist until it is published.
- (9:3) The peer review process is so slow and leaky is it any wonder that university officials might prefer to hold a press conference to announce the results of fast-breaking research?
- (9:5) Given industry's investment in university research, it's not surprising that industry should want to extend its control into the "untouchable" area of peer review.
- (9:7) Corporate sponsorship should be subject to peer review.

(10) The Organization of Academic Work (Department Structure)

- (10:2) Policy concerning university-industry relations should be set and resolved at the department level.

(10:5) University-industry relations are so demanding that they alter, in a substantive way, not only what it means to be an academic researcher, but also the balance of the curriculum offered by the university.

(11) Criteria for Faculty Recruitment and Advancement

(11:1) Where large investments are involved, companies should have the right to review faculty appointments.

(11:2) The availability of industrial funding encourages hiring in specific areas, which may not match education's long-term priorities.

APPENDIX C

RESULTS OF FORCED TWO-FACTOR ANALYSIS



## Results of Forced Two-Factor Analysis

### Factor A

Subjects	Factor Loadings
P2	.742
P9	.732
P4	.728
P12	.726
P5	.691
P17	.689
P6	.680
P10	.657
P1	.618
P11	.608
P3	.608
P13	.604
P16	.596
P8	.593
P15	.539
P7	.510
P14	.457
H3	.432
H7	.300

### Factor B

Subjects	Factor Loadings
H12	.887
H14	.832
H4	.783
H5	.778
H1	.776
H6	.772
H9	.741
H10	.661
H2	.650
H11	.633
H13	.566
H8	.482

APPENDIX D  
FACTOR DEMOGRAPHICS

## Factor Demographics

### Selected Demographics for Factor A Historians

Subject	Factor Loading	Gender
H12	.867	F
H14	.854	F
H1	.799	F
H5	.791	F
H4	.777	F
H6	.768	M
H9	.739	M
H2	.636	M
H10	.636	M
H11	.592	M

The average Factor A historian subject is 45 years of age and has 13.4 years of teaching and research experience. Five factor A subjects are tenured. The striking aspect about Factor A in addition to its all historian cast is the relative location of female members. The top five loadings belong to women. Owing to their high factor loadings, female faculty exert the most influence in characterizing Factor A.<sup>1</sup>

The mean age for subjects in the polymer subject factor is 51 years. All but one subject is tenured and all are male. Teaching and research experience duplicates that of factor A - 13.4 years. Four faculty own patents and three have been (or are) members of corporate advisory panels. Over half (54%) of this group's work is supported by industry grants of various kinds.

### Residual Factors

Residual factors in Q factor analysis often provide some suggestive leads for subsequent research. For example, factors C and E may merit closer inspection due to their age differential. Do they suggest a possible correlation between generation and gestalt (see Kuhn, 1970; Mulkey, 1977; Richards, 1983; and Neustadt & May, 1986)?

#### Factor C (Mean age = 66)

Subject	Factor Loading	Age
P1	.720	64
H7	.691	69
P12	.652	65

#### Factor E (Mean age = 36)

Subject	Factor Loading	Age
P2	.698	34
P11	.670	32
P3	.545	42

## End Notes

1. Factor weight is given as  $w = f/1-f$ , where  $f$  represents the factor loading and  $w$  the weight. Weight derives from a subject's factor loading which reflects the fact that some Q sorts are closer approximations of a factor than others. For example, the factor weight ( $w$ ) for female subject H12 is  $.867/1-.867$  or 3.47. Whereas, H11's factor weight works out to be only 0.91. H11's Q sort, in other words, carries only  $(.91/3.47)$  or 26 percent of the weight of H12's Q sort for calculating factor scores - the basis, remember, for defining factor A's composite opinion. (See Brown, 1980, pps. 241-242, for details.)



## BIBLIOGRAPHY

- Ackoff, R. L. (1974). Redesigning the future: A systems approach to societal problems. New York: John Wiley and Sons.
- Adams, G. B., & Ingersoll, V. H. (1990). Painting over old works: The culture of organization in an age of technical rationality. In B. A. Turner (Ed.), Organizational symbolism (pp. 15-31). Berlin: Walter de Gruyter.
- Aldrich, H. E., & Pfeffer, J. (1976). Environments of organizations. Annual Review of Sociology, 2, 79-105.
- Anderson, C. W. (1987). The human sciences and liberal polity in rhetorical relationship. In J. S. Nelson et al. (Eds.), The rhetoric of the social sciences. Madison: The University of Wisconsin Press.
- Ansoff, H. I. (1965). Corporate strategy. New York: McGraw-Hill Book Co.
- Argyris, C. (1964). Integrating the individual and the organization. New York: Wiley.
- Aronowitz, S. (1988). Science as power: discourse and ideology in modern society. Minneapolis: University of Minnesota Press.
- Ashford, N. A. (1985, Spring). A framework for examining the effects of industrial funding on academic freedom and the integrity of the university. Science, Technology, & Human Values, 8, 16-23.
- Ashley, R. K., & Walker, R. B. J. (1990). Speaking the language of exile: Dissident thought in international studies. International Studies Quarterly, 34, 259-268.
- Astley, W. G. (1985). Administrative science as socially constructed truth. Administrative Science Quarterly, 30, 497-513.
- Astley, W. G., & Van de Ven, A. (1983). Central perspectives and debates in organizational theory. Administrative Science Quarterly, 28, 245-273.
- Astley, W. G., & Zajac, E. J. (1991). Intraorganizational power and organizational design: Reconciling rational and coalitional models of organization. Organizational Science, 2(4), 399-411.
- Attali, J. (1991). Millennium: Winners and losers in the coming world order. New York: Times Books.
- Baer, W. S. (1978). The changing relationships: Universities and other R & D performers. In B. L. R. Smith and J. J. Karlesky (Eds.), The state of academic science: Background papers. New Rochelle, N.Y.: Change Magazine Press.

- Barber, B. (1952). Science and the social order. New York: The Free Press.
- Barnard, C. I. (1938). The functions of the executive. Cambridge, MA: Harvard University Press.
- Barnard, C. I. (1940, Spring). Comments on the job of the executive. Harvard Business Review, 295-308.
- Barnes, B., & Edge, D. (Eds.) (1982). Science in context, Readings in the sociology of science. Cambridge, MA: The MIT Press.
- Barnes, B. (1983). On the conventional character of knowledge and cognition. In K. Knorr-Cetina and M. Mulkey (Eds.), Science Observed. Beverly Hills: Sage Publications.
- Bartunek, J. M. (1984). Changing interpretive schemes and organizational restructuring: The example of a religious order. Administrative Science Quarterly, 29, 355-372.
- Bensman, J., & Lilienfeld, R. (1991). Craft and consciousness: occupational technique and the development of world images (2nd edition). New York: Aldine de Gruyter.
- Benson, J. K. (1983). A dialectical method for the study of organizations. In G. Morgan (Ed.), Beyond method: Strategies for social research. Beverly Hills: Sage Publications.
- Benson, J. K. (1977, March). Organizations: A dialectical process. Administrative Science Quarterly, 22, 1-21.
- Benson, J. K. (1977, Winter). Innovation and crisis in organizational analysis. The Sociological Quarterly, 18, 3-16.
- Berger, P., & Luckman, T. (1967). The social construction of reality. Garden City, NY: Anchor.
- Bernstein, R. J. (Ed.). (1985). Habermas and modernity. Cambridge, MA: The MIT Press.
- Berry, W. (1985). The Loss of the University. In G. Graff and R. Gibbons (Eds.), Criticism in the university. Evanston, IL: Northwestern University Press.
- Bittner, E. (1965). The Concept of Organization. Social Research, 32, 239-255.
- Blau, P. M., & Scott, W. R. (1962). Formal organizations. San Francisco: Chandler.
- Bledstein, B. J. (1976). The culture of professionalism. New York: W.W. Norton and Co., Inc.

- Bleier, R. (Ed.). (1986). Feminist approaches to science. New York: Pergamon Press.
- Blits, J. (Ed.). (1985). The American university. Buffalo: Prometheus Books.
- Bloor, D. (1976). Knowledge and social imagery. London: Routledge & Kegan Paul.
- Blumenstyk, G. (19??). States re-evaluate industrial collaborations built around research grants to universities. The Chronicle of Higher Education, 38, 25.
- Blumenthal, D., Gluck, M., Louis, K. S., & Wise, D. (1986). Industry support of university research in biotechnology. Science, 231, 242-246.
- Blumenthal, D., Gluck, M., Louis, K. S., & Wise, D. (1986). University-industry research relationships in biotechnology: Implications for the university. Science, 232, 1361-66.
- Bourke, J. (1989). Mergermania. The Nation, Oct. 30, 1989.
- Brannigan, A. (1981). The social basis of scientific discoveries. Cambridge: Cambridge University Press.
- Broad, W. J. (1988). As science moves into commerce openness is lost. The New York Times, May 24, 1988.
- Brown, R. H. (1978). Bureaucracy as Praxis: Toward a political phenomenology of formal organizations. Administrative Science Quarterly, 28, 365-382.
- Brown, S. R. (1980). Political subjectivity. New Haven: Yale University Press.
- Brown, S. R. (1985). Comments on "The search for structure." Political Methodology, 11, 109-117.
- Brown, S. R. (1986). Q technique and method: Principles and procedures. In W. D. Berry and M. S. Lewis-Beck (Eds.), New tools for social scientists: Advances and applications in research methods. Beverly Hills: Sage Publications.
- Brown, S. R. (1989). A feeling for the organism: understanding and interpreting political subjectivity. Operant Subjectivity, 12.
- Brown, S. R., & Mathieson, M. (1990) The operantcy of practical criticism. Electronic Journal of Communication, 1.
- Browne, M. W. (1989). "Fusion" claim is greeted with scorn by physicists. The New York Times, May 3, 1989.



- Buckley, W. (1967). Sociology and modern systems theory. Englewood Cliffs, NJ: Prentice-Hall.
- Burns, T., & Stalker, G. M. (1961). The management of innovation. London: Tavistock.
- Burrell, G., & Morgan, G. (1979). Sociological paradigms and organizational analysis. London: Heinemann.
- Calas, M. B., & McGuire, J. B. (1990). Organizations as networks of power and symbolism. In B. A. Turner (Ed.), Organizational symbolism (pp. 95-113). Berlin: Walter de Gruyter.
- Caldart, C. C. (1983, Spring). Industry investment in university research. Science, Technology, & Human Values, 8, 24-32.
- Callon, M., & Vignolle, J. P. (1977). Breaking down the organization: Local conflicts and societal systems of actions. Social Science Information, 16: 147-167.
- The Chronicle of Higher Education Almanac, Sept. 6, 1989.
- Chubin, D. E. (1985, Spring). Open science and closed science: Tradeoffs in a Democracy. Science, Technology, and Human Values, 10, 73-81.
- Clegg, S. R. (1990). Modern organizations: Organizational studies in the postmodern world. Newbury Park, CA: Sage.
- Clifford, J. (1983). On ethnographic authority. Representations, 1, 118-146.
- Clifford, J. (1986). Introduction: Partial truths. In J. Clifford and G. Marcus (Eds.), Writing culture: The poetics and politics of ethnography (pp. 1-26). Berkeley: University of California Press.
- Cooper, R., & Burrell, G. (1988). Modernism, postmodernism and organizational analysis: an introduction. Organizational Studies, 9(1), 91-112.
- Cummings, L. L. (1977). Emergence of the instrumental organization. In P. S. Goodman, et al. (Eds.), New perspectives on organizational effectiveness. San Francisco: Jossey-Bass Publishers.
- Cummings, W. K. (1990, Winter). The culture of effective science: Japan and the United States. Minerva, 28, 426-445.
- Cyert, R. M., & March, J. G. (1963). A behavioral theory of the firm. Englewood Cliffs, NJ: Prentice-Hall.



- Daft, R. L. (1982). Bureaucratic versus nonbureaucratic structure and the process of innovation and change. In S. R. Bacharach (Ed.), Research in the sociology of organizations (pp. 129-166). Greenwich, CT: JAI Press.
- Daly, G. (1991). The discursive construction of economic space: Logics of organization and disorganization. Economy and Society, 20, 79-102.
- Deetz, S. (1985). Critical-cultural research: New sensibilities and old realities. Journal of Management, 11(2), 121-136.
- de Man, P. (1979). The epistemology of metaphor. In S. Sacks (Ed.), On metaphor. Chicago: The University of Chicago Press.
- Dennis, K. E. (1986). Q methodology: Relevance and application to nursing research. Advances in Nursing Science, 8(3), 6-17.
- Der Derian, J. (1990). The (S)pace of international relations: Simulation, surveillance, and speed. International Studies Quarterly, 34, 295-310.
- Dickson, D. (1984). The new politics of science. New York: Pantheon Books.
- DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 48, 147-160.
- DiTomasco, N. (1980). Organizational analysis and power structure research. In W. G. Domhoff (Ed.), Power structure research. Beverly Hills: Sage Publications.
- Douglas, J. D. (Ed.). (1970). Understanding in everyday life: Toward the reconstruction of sociological knowledge. Chicago: Aldine Publishing Co..
- du Gay, P. (1991, Spring). Enterprise culture and the ideology of excellence. New Formations, 13, 45-61.
- Eagleton, T. (1983). Literary theory: An introduction. Minneapolis: The University of Minnesota Press.
- Edwards, R. (1979). Contested terrain: The transformation of the workplace in the twentieth century. New York: Basic Books.
- Emery, F., & Trist, E. L. (1960). Socio-technical systems. In C. W. Churchman and M. Verhulst (Eds.), Management science, models and techniques (Vol. 2, pp. 83-97). New York: Pergamon.
- Emery, F., & Trist, E. L. (1965). The causal texture of organizational environments. Human Relations, 18, 21-32.

- Etzkowitz, H. (1983). Entrepreneurial scientists and entrepreneurial universities in American academic science. Minerva, 21, 198-233.
- Etzkowitz, H. (1989). Entrepreneurial science in the academy: A case of the transformation of norms. Social Problems, 36(1), 14-29.
- Fayol, H. (1919). General and industrial management. London: Pitman (trans. 1949).
- Ferguson, K. E. (1984). The feminist case against bureaucracy. Philadelphia: Temple University Press.
- Footlick, J. K. (1990, Winter/Spring). What happened to the family? Newsweek.
- Forman, P. (1991). Independence, not transcendence, for the historian of science. Isis, 82, 71-86.
- Fowler, D. R. (1984). University-industry research relationships. Research Management, 27(1), 35-41.
- Fraser, N. (1989). Unruly practices: Power, discourse and gender in contemporary social theory. Minneapolis: University of Minnesota Press.
- Freeman, R. E. (1984). Strategic management: A stakeholder approach. Marshfield, MA: Pitman Publishing Inc.
- Frost, P. (1980). Toward a radical framework for practicing organizational science. Academy of Management Review, 5(4), 501-507.
- Frost, P., & Egri, C. (1989). The political process of innovation. In L. L. Cummings and B. M. Staw (Eds.), Research in organizational behavior (Vol. 13). Greenwich, CT: JAI Press.
- Fuchsberg, G. (1989). Universities said to go too fast in quest of profit from research. The Chronicle of Higher Education, April 12.
- Galbraith, J. (1973). Designing complex organizations. Reading, MA: Addison-Wesley.
- Geertz, C. (1980, Spring). Blurred genres: The refiguration of social thought. American Scholar, 2, 165-179.
- Geertz, C. (1983). Local knowledge: Further essays in interpretive anthropology. New York: Basic Books.
- George, J., & Campbell, D. (1990). Patterns of dissent and the celebration of difference: Critical social theory and international relations. International Studies Quarterly, 34, 269-293.

- Georgiou, P. (1973). The goal paradigm and notes toward a counter paradigm. Administrative Science Quarterly, 18, 291-310.
- Giamatti, A. B. (1983). Free market and free inquiry: The university, industry, and cooperative research. In T. W. Langfitt et al. (Eds.), Partners in the research enterprise. Philadelphia: University of Pennsylvania Press.
- Gibbons, M. (1984). Is science industrially relevant? The interaction between science and technology. In M. Gibbons and P. Gummett (Eds.), Science, technology and society today. Manchester: Manchester University Press.
- Gibbons, M., & Gummett, P. (Eds.). (1984). Science, technology and society today. Manchester: Manchester University Press.
- Gibbons, M., & Wittrock, B. (Eds.). (1985). Science as commodity: Threats to the open community of scholars. Essex, UK: Longman Group Limited.
- Giddens, A. (1979). Central problems in social theory: Action, structure and contradiction in social analysis. Berkeley: University of California Press.
- Gitlin, T. (1980, Winter). Postmodernism: Roots and politics. Dissent, 100-108.
- Gladwell, M. (1989). Conflict rules being dropped for scientists. Sunday Republican, December 31, 1989.
- Gouldner, A. W. (1970). The coming crisis of western sociology. New York: Basic Books, Inc..
- Graff, G. (1979). Literature against itself. Chicago: The University of Chicago Press.
- Graff, G. (1985). The university and the preservation of culture. In G. Graff and R. Gibbons (Eds.), Criticism in the university. Evanston, IL: Northwestern University Press.
- Graham, J. (1991). Fordism/Post-Fordism, Marxism/Post-Marxism: The second cultural divide. Rethinking Marxism, 4(1), 39-58.
- Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. American Journal of Sociology, 91, 481-510.
- Gray, B., Bougon, M. G., & Donnellon, A. (1985). Organizations as constructions and destructions of meaning. Journal of Management, 11(2), 83-98.
- Grimes, A. J., & Cornwall, J. R. (1987). The disintegration of an organization: A dialectical analysis. Journal of Management, 13, 69-86.



- Grobstein, C. (1985, Spring). Biotechnology and open university science. Science, Technology, & Human Values, 10, 55-63.
- Gulick, L., & Urwick, L. (1937). Papers on the science of administration. New York: Institute of Public Administration, Columbia University.
- Habermas, J. (1974). Theory and practice. London: Heinemann.
- Hagstrom, W. O. (1965). The scientific Community. New York: Basic Books.
- Hall, E. T. (1981). Beyond culture. New York: Doubleday.
- Hannan, M. T., & Freeman, J. (1977). The population ecology of organizations. American Journal of Sociology, 82, 929-964.
- Harding, S., & Hintikka, M. B. (Eds.). (1983). Discovering reality: Feminist perspectives on epistemology, metaphysics, methodology, and philosophy of science. Dordrecht, The Netherlands: Reidel.
- Heilbroner, R. L. (1988). Behind the veil of economics. New York: W. W. Norton and Co.
- Heydebrand, W. (1977). Organizational contradictions in public bureaucracies: Toward a Marxian theory of organizations. The Sociological Quarterly, 18: 83-107.
- Holstein, W. J., et al. (1990). The stateless corporation. Business Week, May 14, 1990.
- Holtzman, E. (1985). Commentary: Biology faces life - pressures on communications and careers. Science, Technology, & Human Values, 10, 64-72.
- Homans, G. C. (1950). The Human Group. New York: Harcourt.
- Huber, G. P. (1990). A theory of the effects of advanced information technologies on organizational design, intelligence, and decision making. The Academy of Management Review, 15(1), 47-71.
- Hull, D. (1985). Openness and secrecy in science: Their origins and limitations. Science, Technology, & Human Values, 10, 4-13.
- Jacoby, R. (1987). The last intellectuals. New York: Basic Books, Inc.
- Jarusch, K. H. (1983). Higher education and social change. In K. H. Jarusch (Ed.), The transformation of higher learning. Chicago: The University of Chicago Press.
- Johnson, B. (1990). Writing. In F. Lentricchia and T. McLaughlin (Eds.), Critical terms for literary study. Chicago: The University of Chicago Press.



- Katz, D., & Kahn, R. L. (1978). The social psychology of organizations (2nd ed.). New York: John Wiley.
- Katz, D., Maccoby, N., & Morse, N. (1950). Productivity, supervision and morale in an office situation. Ann Arbor, MI: Institute for Social Research, University of Michigan.
- Kenny, J. T. (Ed.). (1988). Research administration and technology transfer. San Francisco: Jossey-Bass Inc.
- Kerlinger, F. N. (1986). Foundations of behavioral research (3rd ed.). New York: Holt, Rinehart and Winston.
- Kidd, C. V. (1959). Basic research - Description vs. definition. Science, 129, 368-371.
- Kieser, A. (1989). Organizational, institutional, and societal evolution: Medieval craft guilds and the genesis of formal organizations. Administrative Science Quarterly, 34, 540-564.
- Kimmelman, M. (1990). The high cost of selling art. Sunday New York Times, April 1, 1990.
- Kirk, R. (1963). Massive subsidies and academic freedom. Law and Contemporary Problems, 28, 607-612.
- Knorr-Cetina, K. D., & Mulkay, M. (Eds.). (1983). Science observed. Perspectives in the social study of science. London: Sage Publications.
- Krimsky, S. (1967). The new corporate identity of the American university. Alternatives, 14(2), 20-29.
- Krimsky, S. (1991). Academic-corporate ties in biotechnology: A quantitative study. Science, Technology, and Human Values, 16, 275-287.
- Kuhn, T. S. (1970). The structure of scientific revolutions. Chicago: University Press.
- Langfitt, T. W. (1983). Partners in the research enterprise. Philadelphia: University of Pennsylvania Press.
- Latour, B., & Woolgar, S. (1979). Laboratory life. The social construction of scientific facts. Beverly Hills: Sage Publications.
- Latour, B. (1983). Give me a laboratory and I will raise the world. In K. D. Knorr-Cetina and M. Mulkay (Eds.), Science observed. Beverly Hills: Sage Publications.
- Lawler, E. E., III. (1977). Reward systems. In J. R. Hackman and J. L. Suttle (Eds.), Improving life at work (pp. 163-226). Santa Monica: Goodyear.

- Lawrence, P. R., & Lorsch, J. W. (1967). Organization and environment: Managing differentiation and integration. Boston: Graduate School of Business Administration, Harvard University.
- Leary, W. E. (1989). Business and scholarship: A new ethical quandary. The New York Times, June, 12, 1989.
- Leatherman, C. (1990). At Brandeis U., an intense debate over how to keep its traditional identity. The Chronicle of Higher Education, 37(8), October 24, 1990.
- Lentricchia, F., & McLaughlin, T. (1990). Critical terms for literary study. Chicago: The University of Chicago Press.
- Levin, D. P. (1990). Honda blurs line between American and foreign. The New York Times, March 14, 1990.
- Longino, H. E. (1981). Scientific objectivity and feminist theorizing. Liberal Education, 67, 187-195.
- Louis, K. S., et al. (1989). Entrepreneurs in Academe: An exploration of behaviors among life scientists. Administrative Science Quarterly, 34, 110-131.
- Lynton, E. A., & Elman, S. E. (1987). New priorities for the university. San Francisco: Jossey-Bass Publishers.
- Lyon, R. E., Jr. (1982). A bridge reconnecting universities and industry through basic research. In J. M. Logsdon (Ed.), The research system in the 1980's. Philadelphia: The Franklin Institute Press.
- Lyotard, J. (1979). The postmodern condition: A report on knowledge. Minneapolis: University of Minnesota Press.
- Maier, N. R. F. (1952). Principles of Human Relations. New York: John Wiley.
- Manicas, P. T. (1987). A History & Philosophy of the Social Sciences. New York: Basil Blackwell, Inc.
- Manning, P. K. (1982). Organizational Work: Structuration of Environments. The British Journal of Sociology, 33(1), 118-134.
- Markoff, J. (1990). A corporate lag in research funds is causing worry. The New York Times, Jan. 23, 1990.
- Mayo, E. (1945). The social problems of an industrial civilization. Cambridge, MA: Harvard University Press.
- McKeown, B., & Thomas, D. (1988). Q methodology. Beverly Hills: Sage Publications.

- McMillen, L. (1989). Growth in corporate aid to public colleges has many private institutions worried. The Chronicle of Higher Education, May 31, 1989.
- Merton, R. K. (1973). Science and the social order. In The sociology of science. Chicago: University of Chicago Press.
- Merton, R. K. (1982). Social research and the practicing professional. Cambridge, MA: Abt Books.
- Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: formal structure as myth and ceremony. American Journal of Sociology, 83, 340-363.
- Miller, P., & O'Leary, T. (1989). Hierarchies and American ideals 1900-1940. The Academy of Management Review, 14(2), 250-265.
- Minsky, L., & Noble, D. (1989). Privatizing Academe: Corporate takeover on campus. The Nation, October, 30, 1989.
- Mooney, J. D., & Reilly, A. C. The principles of organization. New York: Harper.
- Morgan, G. (1980). Paradigms, metaphors and puzzle solving in organizational theory. Administrative Science Quarterly, 25, 605-622.
- Morgan, G. (1983). More on metaphor: Why we cannot control tropes in administrative science. Administrative Science Quarterly, 28, 601-607.
- Mulaik, S. A. (1991). Factor analysis, information-transforming instruments, and objectivity: A reply and discussion. British Journal of Philosophical Science, 42, 87-100.
- Mulkay, M. (1979). Science and the sociology of knowledge. London: George Allen & Unwin.
- Muller, S. (1982). Basic research on campus: A university view. In J. M. Logsdon (Ed.), The research system in the 1980's: Public policy issues. Philadelphia: The Franklin Institute Press.
- National Science Board. (1985). Science indicators 1985. Washington, DC: Author.
- National Science Foundation. (1982). University-industry research relationships: Selected studies. Washington, DC: Author.
- Nelkin, D. (1972). The university and military research: Moral politics at M.I.T.. Ithaca: Cornell University Press.
- Nelkin, D. (1984). Science as intellectual property: Who controls research? New York: Macmillan Publishing Co.



- Nelkin, D., & Nelson, R. (1987). Commentary: University-industry alliances. Science, Technology, and Human Values, 12(1), 65-74.
- Nemetz, P., & Fry, L. W. (1988). Flexible manufacturing organizations: Implications for strategy formulations and organizational design. The Academy of Management Review, 13(4), 627-638.
- Noble, D. F. (1977). American by design: Science, technology, and the rise of corporate capitalism. Oxford: Oxford University Press.
- Noble, D. F., & Pfund, N. E. (1980). The plastic tower: Business goes back to college. The Nation, 231, 246-252.
- Norusis, M. J. (1988). SPSS-X advanced statistics guide (2nd ed.). Chicago: SPSS, Inc.
- Organizations for Economic Co-Operation and Development. (1984). Industry and the university: New forms of co-operation and communication. Paris: Author.
- Parsons, T. (1960). Structure and process in modern societies. Glencoe, IL: Free Press.
- Parthasarthy, R., & Sethi, S. P. (1992). The impact of flexible automation on business strategy and organizational structure. The Academy of Management Review, 17(1), 86-111.
- Patterson, J. (1982). A dissection of attitudes about science. Operant Subjectivity, 5, 58-76.
- Pedhazur, E. J. (1982). Multiple regression in behavioral research (2nd ed.). New York: Holt, Rinehart and Winston.
- Perrow, C. (1979). Complex organizations: A critical essay (2nd ed.). Glenview, IL: Scott, Foresman.
- Pfaff, W. (1989). Barbarian sentiments: How the American century ends. New York: Hill & Wang.
- Pfeffer, J. (1982). Organizations and organizational theory. Cambridge, MA: Ballinger Publishing Co.
- Pfeffer, J., & Salancik, G. R. (1978). The external control of organizations. New York: Harper & Row, Publishers.
- Piore, M. J., & Sabel, C. F. (1984). The second industrial divide: Possibilities for prosperity. New York: Basic Books.
- Pollack, A. (1989). Battles beginning in race to patent superconductors. The New York Times, January 2, 1989.



- Pondy, L. R. (1977). Effectiveness: A thick description. In P. S. Goodman and J. M. Pennings (Eds.), New perspectives on organizational effectiveness. San Francisco: Jossey-Bass Publishers.
- Powers, D. R., et al. (1988). Higher education in partnership with industry: Opportunities and strategies for training, research, and economic development. San Francisco: Jossey-Bass Publishers.
- Prager, D. J., & Omenn, G. S. (1980). Research, innovation, and university-industry linkages. Science, 207, 379-384.
- Price, R. F. (1986). Marx and education in late capitalism. London: Croom Helm.
- Pugh, D. S., & Hickson, D. J. (1976). Organizational structure in its context: The Aston Programme I. London: Saxon House.
- Quinn, R. E., & Cameron, K. (1983). Organizational life cycles and shifting criteria of effectiveness: Some preliminary evidence. Management Science, 29(1), 33-51.
- Quinn, R. E., & McGrath, M. R. (1985). The transformation of organizational cultures: A competing values perspective. In P. J. Frost, et al. (Eds.), Organizational culture. Beverly Hills: Sage Publications.
- Quinn, R. E., & Rohrbaugh, J. (1983). A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis. Management Science, 29(3), 363-377.
- Radin, C. A. (1991). Reputation, research buoy top New England colleges. Boston Globe, September 15, 1991.
- Ranson, S., Hinings, R., & Greenwood, R. (1980). The structuring of organizational cultures. Administrative Science Quarterly, 25, 1-17.
- Ravetz, J. R. (1971). Scientific knowledge and its social problems. Oxford: Clarendon Press.
- Raymond, C. (1989). Cold-Fusion brouhaha signals shifts in the way science proceeds. The Chronicle of Higher Education, May, 24, 1989.
- Reagan, M. D. (1967). Basic and applied research: A meaningful distinction. Science, 155, 1383-1386.
- Reams, B. D., Jr. (1986). University-industry research partnerships: The major legal issues in research and development agreements. Westport, CT: Quorum Books.
- Reich, C. A. (1970). The greening of America. New York: Bantam Books.

- Reich, R. B. (1989). The quiet path to technological preeminence. Scientific American, 261(4), 41-47.
- Richards, S. (1987). Philosophy & sociology of science: An introduction (2nd ed.). Oxford, UK: Basil Blackwell.
- Ricoeur, P. (1979). The model of the text: Meaningful action considered as text. In P. Rabinow and W. M. Sullivan (Eds.), Interpretive social science: A reader (pp. 73-101). Berkeley: University of California Press.
- Riley, P. (1983). A structurationist account of political culture. Administrative Science Quarterly, 28, 413-437.
- Roethlisberger, F. J., & Dickson, W. J. (1939). Management and the worker. Cambridge, MA: Harvard University Press.
- Rose, M. (1985). Re-working the work ethic. New York: Schocken Books.
- Rosen, M. (1987). Critical administrative scholarship, Praxis, and the academic workplace. Journal of Management, 13(3), 573-586.
- Rosenzweig, R. M. (1982). The research universities and their patrons. Berkeley: The University of California Press.
- Rosenzweig, R. M. (1985). Research as intellectual property: Influences within the university. Science, Technology, & Human Values, 10: 41-48.
- Roy, D. (1952). Quota restriction and goldbricking in a machine shop. American Journal of Sociology, 57, 427-442.
- Roy, R. (1972). University-industry interaction patterns. Science, 178, 955-960.
- Rule, J. B. (1988, Fall). Biotechnology: Big money comes to the university. Dissent, 430-436.
- Sayles, L. R. (1958). Behavior of industrial work groups. New York: John Wiley.
- Schaffer, E. (1989). The university in service to technocracy. Educational Theory, 30(1), 47-52.
- Schiller, D. (1988). How to think about information. In V. Mosco and J. Wasko (Eds.), The political economy of information. Madison: The University of Wisconsin Press.
- Science 220, June 10, 1983, p. 1123.
- Scott, W. R. (1987). Organizations: Rational, natural and open systems (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall, Inc.

- Seashore, S. E. (1954). Group cohesiveness in the industrial work group. Ann Arbor: Institute for Social Research, University of Michigan.
- Selznick, P. (1948). Foundations of the theory of organization. American Sociological Review, 13, 25-35.
- Selznick, P. (1949a). Leadership in administration. New York: Harper & Row, Publishers.
- Selznick, P. (1949b). TVA and the grass roots. Berkeley: University of California Press.
- Shore, B. (1991). Twice-born, once conceived: Meaning construction and cultural cognition. American Anthropologist, 93, 1.
- Silverman, D. (1971). The theory of organizations. New York: Basic Books.
- Simon, H. A. (1957). Administrative behavior (2nd ed.). New York: Macmillan.
- Smircich, L. (1983). Concepts of culture and organizational analysis. Administrative Science Quarterly, 28, 339-358.
- Smircich, L., & Calas, M. B. (1987). Organizational culture: A critical assessment. In F. M. Jablin, L. L. Putnam, K. H. Roberts and L. W. Porter (Eds.), Handbook of organizational communication (pp. 228-263). Newbury Park, CA: Sage.
- Smircich, L., & Stubbart, C. (1985). Strategic management in an enacted world. Academy of Management Review, 10(4), 724-736.
- Smith, B. L. R., & Karlesky, J. J. (1978). The future research role of American universities. In B. L. R. Smith and J. J. Karlesky (Eds.), The state of academic science: Background papers. New York: Change Magazine Press.
- Smith, D. N. (1974). Who rules the universities? New York: Monthly Review Press.
- Snow, C. P. (1959). The two cultures and the scientific revolution. London: Cambridge University Press.
- Stankiewicz, R. (1986). Academics and entrepreneurs: developing university-industry relations. New York: St. Martin's Press, Inc.
- Steele, R. S. (1979). Psychoanalysis and hermeneutics. International Review of Psycho-Analysis, 6, 389-411.
- Stephenson, W. (1953). The study of behavior: Q-technique and its methodology. Chicago: The University of Chicago Press.



- Stephenson, W. (1983). Against interpretation. Operant Subjectivity, 6, 73-103.
- Stewart, J. J. (1978). Critical theory and the critique of conservative method. The American Sociologist, 13, 15-22.
- Taylor, C. (1979). Interpretation and the sciences of man. In P. Rabinow and W. M. Sullivan (Eds.), Interpretive social science: A reader (pp. 25-71). Berkeley: University of California Press.
- Taylor, F. W. (1911). The principles of scientific management. New York: Harper.
- Thompson, J. D. (1967). Organizations in action. New York: McGraw-Hill.
- University/Industry Alliances. (1988). Hearing before the Subcommittee on Science, Research and Technology, 100th Congress, 2nd Session, February 8, 1988, No. 90. Washington, DC: U.S. Government Printing Office.
- U.S. Congress, Office of Technology Assessment. (1984). Commercial biotechnology: An international analysis. Washington, DC: GPO.
- Vajirakachorn, S., & Sylvia, R. D. (1990). Administrative attitudes of elite officials in a Buddhist polity. Operant Subjectivity, 13, 163-174.
- Van de Ven, A. H. (1986). Central problems in the management of innovation. Management Science, 32, 590-607.
- Van Maanen, J. (1983). Reclaiming qualitative methods for organizational research: A preface. In J. Van Maanen (Ed.), Qualitative methodology. Beverly Hills: Sage Publications.
- Veblen, T. (1904). The theory of business enterprise. New York: Scribner's.
- Veysey, L. R. (1965). The emergence of the American university. Chicago: The University of Chicago Press.
- Vroom, V. H. (1960). Some personality determinants of the effects of participation. Englewood Cliffs, NJ: Prentice-Hall.
- Wayne, L. (1989). Arms makers gird for peace. The New York Times, December 17, 1989.
- Weber, M. (1946). From H. H. Gerth and C. W. Mills (Eds.), Max Weber: Essays in sociology. New York: Oxford University Press.
- Weick, K. E. (1976). Educational organizations as loosely coupled systems. Administrative Science Quarterly, 21, 1-19.



- Weick, K. E. (1977a). Enactment processes in organizations. In B. M. Staw and G. R. Salancik (Eds.), New directions in organizational behavior. Chicago: St. Clair Press.
- Weick, K. E. (1977b). Re-Punctuating the Problem. In P. S. Goodman and J. M. Pennings (Eds.), New perspectives on organizational effectiveness. San Francisco: Jossey-Bass Publishers.
- Weick, K. E. (1979). The social psychology of organizing (2nd ed.). Reading, MA: Addison-Wesley.
- Wernick, A. (1991). Global promo: The cultural triumph of exchange. Theory, Culture & Society, 8, 89-109.
- Werth, B. (1989). The AIDS windfall. New England Monthly, 5(6), 38-47.
- Whitley, R. (1977). Organizational control and the problem of order. Social Science Information, 16(2), 169-189.
- Whitley, R. (1984). The intellectual and social organization of the sciences. Oxford: Clarendon Press.
- Whyte, W. F. (1951). Small groups and large organizations. In J. H. Rohrer and M. Sherif (Eds.), Social psychology at the crossroads. New York: Harper.
- Williamson, O. E. (1975). Markets and hierarchies: Analysis and antitrust implications. New York: Free Press.
- Wolfe, D. (1978). Forces affecting the research role of universities. In B. L. R. Smith and J. J. Karlesky (Eds.), The state of academic science: Background papers. New York: Change Magazine Press.
- Wolin, S. S. (1981). Higher education and the politics of knowledge. Democracy, 1(2), 38-52.
- Woodward, J. (1958). Management and Technology. London: HMSO.
- Woodward, J. (1988). Industrial organizations: Theory and practice. London: Oxford University Press.
- Woolgar, S. (Ed.) (1988). Knowledge and reflexivity: New frontiers in the sociology of knowledge. Beverly Hills, CA: Sage Publications.
- York, C. M. (1978). Targeted research: An American tradition. In B. L. R. Smith and J. J. Karlesky (Eds.), The state of academic science: Background papers. New York: Change Magazine Press.
- Zeitz, G. (1980). Interorganizational dialectics. Administrative Science Quarterly, 25, 72-78.
- Zey-Ferrell, M. (1981). Criticisms of the dominant perspective on organizations. The Sociological Quarterly, 22: 181-205.

Zucker, L. G. (1983). Organizations as institutions. In S. B. Racharach (Ed.), Research in the sociology of organizations (Vol. 2).

