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ABSTRACT

This study examined the relationship between organizational form and faculty behavior for biotechnology faculty in research universities. In particular the study looked at the perceptions and role of nondepartmental organized research units as compared to the more traditional university structures of discipline rank, tenure status,and institutional prestige. The population for the study consisted of three research universities with biotechnology programs focused on regional economic development. Fifty-eight academic administrators and faculty members in biotechnology and related disciplines were interviewed. Analysis of the data found that, although formal research structure influenced faculty behavior, professors in research universities cared most about the values and norms of their academic discipline and their standing in the profession overall. Faculty members in research universities appeared to possess scarce skills and knowledge and have substantial control over their time. Faculty reward structure in these institutions was dependent on external peer review and participation in professional societies. Thus the effect of any mechanism for organizing faculty research depends on how well the structure matches the values and norms of faculty culture. The effect of any such structure also depends on local circumstances, the environment, and the goals of the institution. (Includes 22 references.) (JB)

The Organization of Academic Research: Faculty Behavior and Perceptions

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The Organization of Academic Research: Faculty Behavior and Perceptions

Abstract

Conventional wisdom on interdisciplinary research assumes that nondepartmental units such as programs, centers, and institutes are often productive and effective ways to organize research faculty. This article examines the relationship between organizational form and faculty behavior for biotechnology faculty in research universities. The authors find that internal organizational structure is related to differences in the behavior and perceptions of individual faculty members. However, structural influences are overshadowed by other factors, especially academic discipline, rank, and tenure status.

The Organization of Academic Research: Faculty Behavior and Perceptions

In an era of contracting fiscal resources, colleges and universities increasingly have turned to research and technology transfer as funding sources. This movement is consistent with the dominant faculty reward structure in academe, where both personal and institutional prestige rest on research productivity (Fairweather 1992). This movement is also in part a response to critics of the traditional faculty focus on training citizens and conducting basic research. Particularly in a global economy, some observers claim that more direct faculty involvement in technology transfer is needed (Chmura, Henton, and Melville 1988; Tornatzky and Fleisher 1990, pp. 236-257).

Concurrent with the pursuit of research funding has been a remarkable transformation in the way that colleges and universities structure research. Universities have implemented, by the thousands, nondepartmental organized research units (ORUs) such as research institutes, centers, business incubators, consortia, and other structures. One review of the literature (Fairweather 1989) cited studies showing that almost all the nation's major research consortia between academe and industry have been established since 1979, and that the number of industry-university research and development consortia increased by a multiple of five during a three-year period in the 1980s.

ORUs are particularly appealing to academic administrators because they appear responsive to societal and economic pressures which have placed a premium upon multidisciplinary cooperation and on research with a process and product orientation. Administrators have assumed that ORUs will attract

funding, particularly from industry, and promote interdisciplinary cooperation while providing a buffer against direct involvement in commercialization. Ideally, ORUs would provide a sufficiently "academic" environment to protect faculty choice and academic freedom while infusing sufficient interest in multidisciplinary work and technology transfer to benefit society (and to garner additional monies for colleges and universities). Although academic administrators believe that ORUs can achieve institutional goals while defusing problems such as conflicts of interest or a de-emphasis of teaching, the supporting empirical evidence is lacking (Friedman and Friedman 1985, 1986).

Why the concern with programmatic, sponsor-oriented research? Previous survey work by Blumenthal and colleagues (1986) showed that biotechnology faculty whose research was funded by industry differed in several ways--some desirable, some undesirable--from faculty without such support. According to that study, faculty with ties to industry published at higher rates and participated more in administrative and professional activities, but they also were more likely to be involved in trade secrets and to be influenced in their choice of research projects.

In contrast to the perception of ORUs as effective mechanisms for guiding faculty behavior, well-documented studies have repeatedly shown that faculty values and behaviors relate powerfully to academic discipline, rank, tenure status, institutional type, and institutional prestige (Boyer 1990; Caplow and McGee 1958; Jencks and Reisman 1968; Ladd and Lipset 1975; Nora and Olivas 1988; Wilson 1942, 1979). If faculty culture is as strong as these studies have indicated, it can limit the ability of ORUs to alter the

fundamental terms in which the professoriate defines itself.

This paper examines the relative merits of these two distinct postulates about faculty behavior. The first, espoused by administrators seeking to advance technology transfer while maintaining academic integrity, is that ORUs are effective structures for socializing faculty and guiding their behavior. The other states that faculty respond to the traditional trappings of the job, namely discipline, rank, tenure status, and institutional prestige.

Organized Research Units in Biotechnology

During 1990 and 1991 we conducted a multiple case study involving faculty in biotechnology and related fields. The study was an effort to find out how different organizational forms--traditional departments and three types of ORUs (programs, centers, and institutes)--affected the behaviors and perceptions of faculty members.

We focused on biotechnology for two reasons. First, other studies have shown that the nature, acceptability, form of sponsorship, and procedures for corporate involvement all differ by discipline. What scholars learn about ORUs in agriculture, for example, may not hold for computer science (Fairweather 1989; Friedman and Friedman 1986). Second, biotechnology is at the forefront of the university-industry research connection. It epitomizes the transformation of a basic science into an industry, and it aligns with universities as closely as does any other field of study (Kenney 1986).

Methodology

Site Selection

The population for this study consisted of research universities with biotechnology programs focused on regional economic development. Starting with the Directory of Biotechnology Centers (North Carolina Biotechnology Center 1989), we identified 39 university-related centers of biotechnology. These ranged from independent institutions, such as Lehigh and Case Western Reserve, to the largest public universities, such as the University of Michigan and Ohio State University. Thirty-three of the 39 centers are operated by public universities. Two-thirds have annual research funding of two million dollars or less, and the largest single funding source is state government.

Focusing on the 15 sites in the Northeast and Middle-Atlantic regions, we selected three sites which varied on source of control (public or private), enrollment, size of external funding for biotechnology research, professed institutional interest in technology transfer, and type of ORU. Table 1 profiles the sites. They ranged in size from 6,500 students to 38,000 students. Our study did not focus on institutional prestige as a causal factor, but each of the institutions was a highly reputable research university, based on Carnegie type (Carnegie 1987), total research funds, and academic reputation.

[Insert Table 1 here]

We used a continuum (adapted from Geiger 1990) to define the nature of the biotechnology unit at each site we visited. The possible positions on this continuum, as illustrated in Figure 1, are the department, program,

center, and institute. At one extreme of this continuum are departments, in which values and practices follow the traditional academic model, and in which research emanates from traditional disciplinary paradigms. At the other extreme are institutes that are intended to pursue research because of its presumed utility to sponsors. The relative position of a given unit along the continuum depends upon four categories of characteristics: mission; administrative arrangement; faculty appointment, evaluation, and tenure; and curricular authority and responsibility.

[Insert Figure 1]

Table 2 summarizes data on these organizational characteristics for the three research sites. At the "Institute" university, biotechnology displayed all the traits of a sponsor-oriented research institute. The Biotechnology Institute at that site placed a priority on funded research and on partnerships with external agencies. The Institute, not a department or college, hired and tenured its faculty. The unit was organized and funded much like a separate campus within the state university system, not as a unit of the university. The Institute hired its tenure track faculty primarily as researchers. Curricular authority and responsibility were very low. The Institute did not offer courses for credit, nor did it award degrees.

[Insert Table 2]

By contrast, the unit characterized as a "Biotechnology Program" at another site was an academically-based effort to encourage interdisciplinary research. The Program at that site existed within its university's academic organization, and it complemented the goals of colleges and departments. The Program had no authority in faculty personnel matters, and it did not impinge

on the curricular authority or responsibility of faculty. The Program essentially operated as a magnet for programmatic funding in biotechnology, and as a mechanism for distributing that funding to departmental faculty.

The unit characterized as a "Biotechnology Center" fell between the extremes of an academically-oriented program and an externally-oriented institute. The mission of the Biotechnology Center included both teaching and technology transfer. The unit did not impinge on departmental prerogatives for the hiring, evaluation, and tenure of instructional faculty, but it did employ principal researchers on temporary research funds. The unit was administered within academic lines, reporting to the provost, but most affiliated faculty members chose offices and labs in the biotechnology facility, not in their home departments.

Data Collection and Analysis

Using case study methodologies (Miles and Huberman 1984; Yin 1984), we interviewed 58 academic administrators and faculty members in biotechnology and in related disciplines such as plant pathology, chemical engineering, and biochemistry. Faculty selected for study ranged from traditional departmental appointments to appointments in ORUs. Catalogs, budget reports, measures of research funding, and other institutional information complemented the structured interviews. Analyses centered on comparisons between faculty with appointments in ORUs ("ORU faculty") with those whose sole appointment was in an academic department ("departmental faculty").

To study how different organizational forms affect faculty behavior, five topics were chosen to guide interview questions. Based on the work by Bowen and Schuster (1986) and Boyer (1990), these topic areas were teaching,

advising, research, scholarship, and values and perceptions. Table 3 summarizes the measures used for each of these five concepts; these measures were the basis for detailed questions about views on the benefits and drawbacks of industry funding; the possible conflicts among teaching, research, and service; the balance between basic and applied research; rules and restrictions on publishing research findings; and the choice of research topics and methods.

[Insert Table 3]

Results

We analyzed the data for differences between ORU and department faculty, as well as for differences related to faculty culture.

Differences Between ORU and Department Faculty

When comparing the behaviors of department-primary faculty to the behaviors of faculty who were members of, or formally affiliated with, one of the organized research units in biotechnology, we discovered the following: (a) differences in publication activity; (b) differences in views on the relative advantages of ORUs and departments; (c) few systematic differences in teaching and advising; and (d) few systematic differences in the magnitude of funding or in the proportion of industry research funding.

Publication Activity. Publication data revealed that departmental faculty published more frequently in refereed journals than did their colleagues formally affiliated with biotechnology units. Two-thirds of departmental faculty published (as authors or co-authors) at least three articles per year in refereed journals; fewer than half of ORU faculty published as often.

Perceptions of ORUs and Industry Linkages. ORU faculty tended to have more favorable views on ORUs than did departmental faculty. This finding was not surprising; faculty can exercise some self-selection in terms of where they are employed. Departmental faculty members also were more likely to have stronger positive or negative views on industry linkages than were faculty with ORU ties. Departmental faculty members typically viewed government funding as the most desirable form of support. Government research has great legitimacy (especially important to junior faculty), allows greater freedom in the choice of topic and method, and is more likely to be funded through a single large grant. Regardless of departmental or ORU affiliation, faculty tended to view industry funding as an opportunity for alternative support in the face of an increasingly stringent climate for National Science Foundation and National Institutes of Health grants. ORU faculty members were much more likely to discuss both the advantages and disadvantages of industry research relationships; perhaps they have been exposed to more discussion of this issue.

Teaching and Advising. Teaching and advising loads did not vary among faculty on the basis of organizational home. Faculty members in this study typically taught about two courses per year, ranging from zero to three courses. Doctoral advising varied slightly by organizational location; departmental faculty members supervised as many as 12 dissertations, with a median of three, compared to nine and two, respectively, for ORU faculty.

Magnitude and Sources of Research Funding. An important test of ORUs is whether ORU faculty are more effective than departmental faculty in garnering research funding. Unfortunately, this question was difficult to answer. Much

funding in biotechnology is on a multiyear basis; many grants involve multiple researchers; some large grants are made to programs, others to individuals; some institutional data systems track budgeted amounts, others expenditures; and individual self-reports are imprecise. A valid comparison would also need to control for factors such as academic discipline and individual rank. At the "Institute University," where we found the most useful data on research expenditures, external funding per full-time tenure track faculty members averaged $45,000 in ORUs and $30,000 in the most closely related departments. These tentative findings suggest that ORU faculty may have been more successful than department faculty in garnering grants and contracts.

Differences Related to Faculty Culture

More potent than organizational structure as an influence on behavior were traditional elements of faculty culture: academic discipline, rank, and tenure status.

Academic Discipline. Differences between faculty based on academic discipline--chemistry and chemical engineering versus the life sciences--were more marked, more consistent, and affected more variables than differences based on organizational affiliation. For example, research funding from industry varied slightly when comparing faculty in ORUs with departmental faculty (9 percent versus 5 percent in one institution, 13 percent versus 9 percent in another). Disciplinary effects were far more dramatic: chemists and chemical engineers reported external funding of about $200,000 each, whereas faculty in biology averaged about $50,000.

Rank and Tenure Status. Rank and tenure status also were strong indicators of faculty attitudes and behavior. Senior faculty consistently had higher

publication output in refereed journals and lower teaching loads than junior faculty. Tenure and rank had a stronger effect on individual behaviors than on individual attitudes. These results are consistent with research indicating that junior faculty are expected to emulate senior faculty in their disciplines (e.g., Tuckman 1979).

Summary

The organization and structure of academic research does affect faculty behavior. Faculty members varied in behaviors and perceptions depending upon whether they were primarily affiliated with an academic department or an ORU. However, traditional elements of the faculty culture, especially academic discipline, seniority, and tenure status, were more powerful influences on faculty behavior and attitudes than was organizational location.

Conclusions and Policy Implications

Although formal research structures influence faculty behavior, the findings of this study indicate that what matters most to professors in research universities are the values and norms of their academic discipline, and their standing in the profession writ large. This is true for several reasons. Faculty members in research universities possess scarce skills and knowledge, and have substantial control over their time. The faculty reward structure in these institutions is dependent upon external peer review and on participation in professional societies. To pursue a research agenda, faculty in research universities also have a dependent relationship with outside funding agencies. As a result, the conduct and tendencies of a faculty member--teaching, publication, research, career progression, job mobility,

attitudes--depend substantially on conditions outside of his or her university. These interinstitutional factors restrict the ability of ORUs to channel the behavior of a given university's research faculty.

The belief that structure (as represented by ORUs) is the dominant influence on faculty members is mistaken. The effect of any mechanism for organizing faculty research depends on how well the structure matches with the values and norms of faculty culture. Individual faculty members identify strongly with their disciplinary colleagues both within the institution and elsewhere. The effect of organizational structure for a particular campus also depends on local circumstances, the environment, and the goals of the institution.

These findings suggest that the development and operation of any ORU should take into account the likely effect of existing departments. Departments are a fundamental and ready-made building block of the academy. Departments are the focal point, within an institution, for the delivery of the core mission of a research university: research, instruction, and service. Departments are a reflection of the structure of academic disciplines, and they are the traditional locus for faculty hiring, evaluation, promotion, and tenure. For tenure-track faculty, ORUs which run counter to the norms of academic departments run the risk of alienating faculty and of losing effectiveness.

Organized research units are valuable. They can and do make important contributions to promoting interdisciplinary work across departments and colleges. ORUs allow faculty to respond to the demands of the research economy and to keep pace with or lead changes in the organization of

scientific knowledge. However, ORUs have a relatively limited influence on the behaviors of tenure-track faculty.

Table 1

Profile of Research Sites

	"Institute" University	"Center" University	"Program" University
Institutional control	Public	Private	Private
Total enrollment (main campus headcount)	38,000	6,500	12,500
Freshmen with 600 or Higher on Mathematics SAT	42%	77%	87%
Graduate enrollments, % of total	24%	31%	44%
Biotechnology startup year	1984	1986	1983
Biotechnology technology transfer orientation	Very High	Moderate to High	Moderate

Table 2

Organizational Characteristics of Biotechnology Units

	"Institute" University	"Center" University	"Program" University
Research Funding	$4.2 million	$.7 million	$3.8 million
Mission of Biotech Unit	Promote research & university-government-industry partnerships.	Research in support of teaching & technology transfer.	Development and dissemination of knowledge & the transfer of technology.
Administrative Arrangements of Biotech Unit	High autonomy. Director approximates a campus president. Line-item funding from state for standing faculty.	Reports to provost. Administered by faculty members and dept. or program heads.	Reports to provost. Administered by faculty with participation of industry reps on proposal review.
Faculty Hiring, Tenure, & Evaluation	Within biotech unit, with some departmental input.	Departmental.	Departmental.
100% Researchers May Be on Tenure Track	Yes.	No.	No.
BT Unit Has Soft $ PI's	Yes.	Yes.	No.
All Faculty in BT Bldg	Yes.	Mostly Yes.	No.
Curricular Authority of Biotech Unit	None.	Moderate.	None.
Curricular Authority of Biotech Faculty	Moderate.	High.	High.

Table 3

Variables and Measures of Faculty Behavior

Variables	Measures
1. Teaching	Academic year instructional load: 3- or 4-credit courses for which faculty member has sole or primary responsibility
2. Advising	Number of doctoral dissertations currently under supervision
3. Research	Amount of externally funded research
	Proportions of research funded by federal government, state government, business, and other (e.g., foundations)
4. Scholarship	Number of articles in refereed journals in past three years (as sole or co-author)
5. Values & Perceptions	Opinions on benefits/drawbacks on industry research partnerships
	Opinions on relative benefits/ drawbacks of departments and organized research units

Figure 1

Typology of Faculty Units

DEPARTMENT	PROGRAM	CENTER	INSTITUTE

Traditional Academic Values <----------> External Sponsor/Funding Motives

Typical Characteristics

Mission:
Transmit & expand knowledge

Administration:
Department-college-provost

Faculty Appointment:
College based

Curricular Authority:
High

Mission:
Technology transfer

Administration:
Autonomous

Faculty Appointment:
Independent of college

Curricular Authority:
None

Note. Adapted from Geiger, 1990.

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Authors' Notes

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