UNIVERSITY-INDUSTRY ALLIANCES: A STUDY OF FACULTY ATTITUDES TOWARD THE EFFECTS OF ALLIANCES ON THE GOVERNANCE AND OPERATIONS OF INSTITUTIONS OF HIGHER EDUCATION

DISSERTATION

Presented to the Graduate Council of the University of North Texas in Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Olufemi Abegunde, B.Th., M.A.
Denton, Texas
August, 1992
UNIVERSITY-INDUSTRY ALLIANCES: A STUDY OF FACULTY ATTITUDES TOWARD THE EFFECTS OF ALLIANCES ON THE GOVERNANCE AND OPERATIONS OF INSTITUTIONS OF HIGHER EDUCATION

DISSERTATION

Presented to the Graduate Council of the University of North Texas in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

By

Olufemi Abegunde, B.Th., M.A.

Denton, Texas

August, 1992

The central purpose of this study was to compare the attitudes of faculty in applied sciences to the attitudes of faculty in liberal arts and other selected fields to determine if they differ significantly from each other in their perceptions of the effects of university-industry alliances on campus governance and operations. Secondary purposes were (a) to appraise the debate on alliances and the effects of alliances on academic values and (b) to contribute to the literature concerning alliances and their potential for improving higher education.

Results of this study revealed that the two groups differed significantly with respect to opportunities available to them in alliances and in their perceptions of the effects of alliances on the autonomy of universities and academic values such as openness in research and freedom to teach and publish research discovery without the dictate of any external factors. Results of the study also revealed that the two groups of faculty were similar in their perceptions of the financial benefits, prestige, and
improvement in instruction that alliances have brought to institutions of higher education.
TABLE OF CONTENTS

LIST OF TABLES

Chapter

1. INTRODUCTION
   Statement of Problem
   Purpose of the Study
   Research Questions
   Definition of Terms
   Limitation of the Study
   Background and Significance
   Summary

2. REVIEW OF THE LITERATURE
   Introduction
   Evolution of University-Industry Alliances
   Involvement of the Federal Government in University-Industry Alliances
   Typology of University-Industry Alliances
   Factors Determining Choice of Alliances Among Universities
   Factors Determining Choice of Alliances Among Industries
   The Philosophy of the Federal Government
   The Philosophy of Higher Education
   Extent of Industrial Funding of University Research and Development
   Implications of University-Industry Alliances for Higher Education
   Summary

3. RESEARCH METHODS AND PROCEDURES
   Introduction
   Rationale for Using University of Texas at Dallas and University of North Texas for the Study
   Collection of Data
   Summary
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. ANALYSIS OF DATA</td>
<td>52</td>
</tr>
<tr>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>Respondents</td>
<td></td>
</tr>
<tr>
<td>Demographics of Respondents</td>
<td></td>
</tr>
<tr>
<td>Operational and Administrative Functions of the University</td>
<td></td>
</tr>
<tr>
<td>Quality of Scholarship and Instruction</td>
<td></td>
</tr>
<tr>
<td>Ethical and Legal Abuses of Alliances</td>
<td></td>
</tr>
<tr>
<td>Academic Freedom Versus Contractual Agreements</td>
<td></td>
</tr>
<tr>
<td>Effects of Alliances on Faculty Reward Structures</td>
<td></td>
</tr>
<tr>
<td>The Future of Business Partnership in Higher Education</td>
<td></td>
</tr>
<tr>
<td>Summary of Major Findings</td>
<td></td>
</tr>
<tr>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>5. SUMMARY OF MAJOR FINDINGS, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH</td>
<td>85</td>
</tr>
<tr>
<td>Summary of Major Findings</td>
<td></td>
</tr>
<tr>
<td>Similarities</td>
<td></td>
</tr>
<tr>
<td>Discussion</td>
<td></td>
</tr>
<tr>
<td>Conclusions</td>
<td></td>
</tr>
<tr>
<td>Recommendations</td>
<td></td>
</tr>
<tr>
<td>APPENDICES</td>
<td>97</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>123</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Academic Discipline, Departmental Affiliation,</td>
<td>56</td>
</tr>
<tr>
<td>Rank, Highest Degree and Experience in</td>
<td></td>
</tr>
<tr>
<td>University-Industry Alliances of Applied Sciences Faculty Members</td>
<td></td>
</tr>
<tr>
<td>2. Academic Discipline, Departmental Affiliation,</td>
<td>58</td>
</tr>
<tr>
<td>Rank, Highest Degree, and Experience in</td>
<td></td>
</tr>
<tr>
<td>University-Industry Alliances of Faculty Members in Liberal Arts</td>
<td></td>
</tr>
<tr>
<td>3. The Perceptions of Applied Sciences Faculty Versus</td>
<td>60</td>
</tr>
<tr>
<td>Liberal Arts Faculty Concerning the Possibility that Alliances Have</td>
<td></td>
</tr>
<tr>
<td>Effects on the Missions, Autonomy, Lines of Administrative Control,</td>
<td></td>
</tr>
<tr>
<td>Institutional Consulting Policies, Image, Fiscal Stability of the</td>
<td></td>
</tr>
<tr>
<td>University, and Administrative Handling of Allegations of Abuse of</td>
<td></td>
</tr>
<tr>
<td>Alliances</td>
<td></td>
</tr>
<tr>
<td>4. The Perceptions of Applied Sciences Faculty Versus</td>
<td>64</td>
</tr>
<tr>
<td>Liberal Arts Faculty Concerning the Possibility that Alliances Affect</td>
<td></td>
</tr>
<tr>
<td>Collegial Relationships, Quality of Faculty, Research Choice, Openness</td>
<td></td>
</tr>
<tr>
<td>in Research, Quality of Instruction, and Peer Review of Research</td>
<td></td>
</tr>
<tr>
<td>Findings</td>
<td></td>
</tr>
<tr>
<td>5. Faculty Estimates of the Magnitude of Conflict of Interest, Equity</td>
<td>68</td>
</tr>
<tr>
<td>Holding, Amount of Time Devoted to Consulting Compared to Amount of</td>
<td></td>
</tr>
<tr>
<td>Time Spent with Students by Consulting Faculty, and the Possibility</td>
<td></td>
</tr>
<tr>
<td>of State Involvement in Policy Design for Consulting</td>
<td></td>
</tr>
<tr>
<td>6. The Responses of Applied Sciences Faculty Versus Liberal Arts</td>
<td>71</td>
</tr>
<tr>
<td>Faculty Concerning the Amount of Restrictions that Contractual</td>
<td></td>
</tr>
<tr>
<td>Agreements in Research Impose on Their Freedom to Publish,</td>
<td></td>
</tr>
<tr>
<td>Discuss Research With Colleagues, and Teach Findings to Students</td>
<td></td>
</tr>
</tbody>
</table>
7. The Responses of Applied Sciences Faculty Versus Liberal Arts Faculty Concerning the Possibility That Alliances Could Alter the Basis for Salary Increase, Promotion, Tenure, Research Incentives, and Possibility of Establishing Centers for Commercialization of Faculty Research, and Opportunity for Involvement in Alliances for Extra Income . . .  76

8. Future Relationships Between Higher Education and Businesses in the Perceptions of Applied Sciences Faculty Versus Liberal Arts and Other Faculty With Respect to Supply of Faculty, University Dependence on Industrial Funds, Creation of Monitoring Council, Involvement in Alliances, Support for Nonpaid Consultants, and Sources for Research Funds . . . . . . . . . . . .  79
CHAPTER 1

INTRODUCTION

There was a young lady from Kent
who said she knew what it meant
when men took her to dine,
gave her cocktails, and wine;
she knew what it meant but she went
(Kerr, 1972, p. 69).

Clark Kerr, a renowned administrator in higher
education, used this limerick to depict the consequences
oftentimes associated with external funding of university
research. Kerr concluded that he was "not sure that
universities and presidents always knew what it meant; but
one thing is certain, they went" (p. 69).

The historic Pajaro Dunes Conference of the Association
of American Universities' Committee on University-Industry
Relationships in 1982 and the subsequent conferences and
forums, congressional reports concerning university-industry
relationships, and media reports all attest to the fact that
universities and presidents still avidly pursue external
funds, especially from private business and industry. This
financial exploration, among other things, has brought
colleges and universities and the business world to a unison
variously known as contractual agreement, research
connection/linkage, or innovative alliance.
Since 1973, when the federal government en route to the National Science Foundation and the National Bureau of Standards initiated cooperative research and incentive programs in order to stimulate close ties between universities and private industry, innovative alliances have multiplied in number and size. Although the precise number of alliances remain unknown, their extent and prevalence since 1973 have been magnified by the highly orchestrated multiple-year contracts and multimillion-dollar agreements between businesses and certain research individuals or groups in colleges and universities nationwide.

Additionally, industrial academic research and development expenditures have grown with great rapidity since the 1970s. Nelkin, Nelson, and Kiernan (1987, p. 65) and the National Science Foundation (1990) estimated industrial funding of academic research and development at $84 million in 1973 and $194 million in 1979. This amount rose to $370 million in 1983 and peaked at $7.5 billion in 1989 for research and development in science and engineering alone. As colleges and universities pursue industrial funds in order to fill the financial void created by federal and state governments, many scholars and observers of higher education in the government and the general public have become skeptical about the implications (legal, ethical, and academic) of alliances for colleges and universities (Delgado & Leskovac, 1987; Kerr, 1989).
In its effort to assess the prospects and potential or real implications of alliances between universities and industry, and taxpayers' investment in fundamental research, Congress has conducted a number of hearings and has issued legislation to guide joint research ventures between universities and industry. Within academia, scholars have debated in publications and at conferences whether higher education can align itself with the business world without compromising its basic agendas and missions for teaching, research, and service. On one hand, critics allege that corporate research on campuses has become detrimental to the health of universities and that consulting faculty members have become less effective members of the academic community (Noble, 1986). On the other hand, proponents defend alliances and argue that, aside from financial gifts, higher education needs private industry because of its influence on the public consciousness (Healy, 1979).

Certainly, the attitudes of faculty members toward research are generally guided by how they perceive their functional roles in education, training, and service. While some faculty members perceive their roles as training leaders, others may wish to train professionals. It is possible that faculties' attitudes, formed by their educational backgrounds, talents, and interests, and even their world outlooks, may also influence their orientations toward university-industry alliances and contribute to
protracted debates among them. Given the incredible number of dollars involved in alliances, and the debates among faculty members, relatively few studies have been devoted exclusively to the exploration of the differences in attitudes among faculty members on these issues that dramatically affect them and the organizations to which they belong.

Attitudinal studies have been done since the 1960s to gauge the liberal-conservative attitudes of faculty members toward economic, political, and various academic issues. Popular among researchers in the field are Bowen and Schuster (1986) and Ladd and Lipset (1975). Only recently Nora and Olivas (1988) suggested that senior faculty (the careerists and gatekeepers), especially those in defense and applied research fields, were most supportive of corporate-funded research and that faculty members in the humanities and social sciences were more socially critical and less enthusiastic. They hypothesized that the latter categories of faculty differ because (a) they have less opportunity for participation, (b) they have a "higher minded" view of the roles and missions of the university, and (c) they view liberal arts at the heart of the university and the functional roles of faculty members as assisting students to become literate, humane, and civic-minded.

Nora and Olivas (1988) provoked some fundamental questions that need to be addressed: Are faculty members in
the arts unrealistically critical of corporate-funded research (i.e., because of less opportunity)? Can we draw the conclusion that irrespective of the financial benefit and other benefits of alliances, faculty members in the arts choose to be critical of alliances because of their disciplines? Can we infer that faculty members in the arts pay more attention to the missions of the university than those in applied sciences? What are the implications for their answers? Is such generalization valid or speculative? Lastly, Are there real problems with the partnerships of businesses in higher education that need to be investigated?

This study was not designed to end debate on the controversial effects of alliances on the governance and operations of a campus. It was intended, however, to provide possible answers to some of the questions raised by Nora and Olivas (1988) for the following reasons: (a) the key to the success of university-industry alliances lies in a thorough understanding of how faculty members feel about an issue affecting them and the norms of their organizations and why they feel as they do—about one-third of the members of academia are now involved in consulting; (b) if administrators are to adopt effective policies for accommodating the pluralistic nature of the professorate, there is a need for an open communication of faculty views about alliances; and (c) administrators must not only further their efforts to balance emphasis among various
disciplines, but must also encourage campus-wide participation in alliances, directly or indirectly, through committees or councils and sharing of revenue windfalls resulting from alliances.

Statement of Problem

The problem of this study concerned comparative attitudes of faculty members in liberal arts and faculty members in applied sciences toward the effects of university-industry alliances on the governance and operations of institutions of higher education.

Purpose of the Study

The central purpose of this study was to compare the attitudes of faculty members toward the effects of university-industry alliances on campus governance and operations. Specifically, the attitudes of faculty members in applied sciences were compared to the attitudes of faculty members in liberal arts to determine if they differ significantly from each other in their perceptions of the effects of university-industry alliances on campus governance and operations. Secondary themes of the study were (a) to appraise the debate on alliances and the effects of alliances on academic values, and (b) to contribute to the literature concerning alliances and their potential for improving higher education.
Research Questions

In order to accomplish the purposes of this study, the following questions were constructed.

1. To what extent do faculty members in the arts and faculty members in the sciences differ or agree in their perceptions of the impact of university-industry alliances on the operational and administrative functions of the university?

2. How different or similar are faculty members in the arts and faculty members in the sciences in their views of the effect of alliances on quality of scholarship and instruction?

3. To what extent do faculty members in the arts and faculty members in the sciences differ in their beliefs that ethical and legal abuses of alliances are real?

4. What are the attitudes of faculty members in the arts and faculty members in the sciences toward restrictions and patents under contractual agreements with industries?

5. How significantly different or similar are faculty members in the arts and faculty members in the sciences in their perceptions of the effects of corporate research on the university reward structure?

6. How do faculty members in the arts and faculty members in the sciences foresee the roles of alliances in the governance of the university in the future?
Definition of Terms

In the context of this study, university-industry alliances was defined as contractual agreements, connections, or liaisons, between colleges and universities on the one hand, and private firms on the other, for the following purposes: (a) training and transfer of faculty research to private firm or marketplace for a financial exchange; (b) cost-effectiveness in production, supply of skilled personnel, and enhancing the competitiveness of American businesses in the world economy; (c) improvement of the economic and social benefits of the American general public.

Limitation of the Study

During the past decades, higher education has felt the pressure to respond to the needs of many of its constituencies both in the public sector (i.e., defense research) and in the private sector (i.e., corporate or commercializable research). Because defense research sponsored by the federal government does not typically constitute a contractual agreement or an alliance between higher education and the federal government, it is not included in this study.

Background and Significance

In the past decade, university-industry alliances have gained unprecedented popularity due to cutbacks in federal
and state funding of university research and development. However, the current large number and size of alliances have obviously extended beyond the possibility of merely enhancing revenues for universities on a short-term basis. The rapid growth is also attributable to the roles of the federal and state governments in bringing universities and businesses together to revamp the declining national economy and to revitalize the diminishing competitiveness of American technology in the world market.

University-industry alliances have been welcomed with both enthusiasm and skepticism in Congress, the business world, and academia. Although both federal and state governments enthusiastically encourage academics to work with industrial partners for the common good of the industrial sector, the general public, and higher education itself, the governments have expressed skepticism about some of the potential or real implications of such partnerships. Throughout the 1980s, Congress conducted a number of hearings in order to determine the pervasiveness of alliances, their implications for universities, and also to ascertain the federal role in ensuring a fair return on taxpayer investment in basic research. Legislators in California were pressured by the California Rural Legal Assistance (CRLA) in 1982 to extend the enforcement of the state's fair political practices regulation to all land-grant universities. The regulation requires an individual
faculty member receiving funds from private firms to "declare whether he or she has a financial interest in that firm and the magnitude of that interest" (Tatel & Guthrie 1983, p. 23). The regulation was apparently adopted to curb what the public believed to be ethical and legal abuses of alliances by faculty scientists.

In the private sector, alliances are welcomed with great enthusiasm because (a) universities provide excellent access to up-to-date scientific information and skilled human capital, and (b) industries can increase productivity with minimum costs because most corporate research takes place on university campuses. Bok (1982, p. 160) noted that businesses now spend a lower share of their sales revenues on research and development than they did in the 1960s.

Many administrators and scientists in higher educational institutions view alliances as a viable approach to defray the high costs of reforming their research laboratories, which have been estimated at $15 to $20 billion nationally. Apart from the financial benefits of alliances, higher education has also been exposed to the real world of research. As consulting faculty members visit industrial sites, they see activities that have potential for research and for furthering the training of students (Kruytbosch 1982, pp. 70-73; Patton 1980).

The debate on the controversial implications of alliances among faculty members does not focus immediately
on the financial and prestigious gains derived from working with the private sector. Rather, as many academic scientists, especially in biotechnology, avidly pursue corporate funds, many faculty members are concerned about such ethical and legal dilemmas as compromise and maneuvering of certain academic values in the process of bargaining. Bok (1982, p. 142), for instance, expressed concern that the nature and direction of academic sciences could be "transmuted into something quite unlike the disinterested research for knowledge that has long been thought to animate university professors." Ping (1981, pp. 122-129) and Fairweather (1989, p. 396) also expressed a similar view. They noted that alliances have the potential to distract faculty members from the instructional mission of the universities and to negatively affect the quality of undergraduate instruction. Furthermore, in their own study, Tatel and Guthrie (1983, pp. 21-23) expressed their fear of a weakening of basic research at the expense of proprietary or commercializable research projects.

Many of the studies conducted to determine the extent of effects of alliances on universities' missions and academic values have reported no significant evidence of negative effects. Comprehensive studies by Blumenthal, Gluck, Louis, Soto, and Wise (1986) and Gluck (1987) are good examples of such research. Notwithstanding the results of these studies, however, the debate on the controversial
effects of alliances on the governance of the campus continues with great intensity. Why do some faculty members defend alliances while others are critical of them? To date, relatively few researchers have attempted to gauge the attitudes of faculty members toward alliances. Such research has the potential to explain the structure of the ongoing debate and provide a better understanding of the effects of alliances in the governance of the campus.

Literature on higher education indicates that the institutional views of alliances vary because of the various ways many colleges and universities perceive their functional roles in education, training, and service (Bok, 1982, pp. 61-78). While the leaders of some universities regard their institutions primarily as basic research institutions, others view their universities as being technology- or liberal-arts-oriented. Also, while some institutions have a major goal of training professionals, others have a chartered mission of training leaders.

Similarly, faculty attitudes toward both academic and social issues vary due to the perspectives of their personal and educational backgrounds, talents and interests, and even world outlooks. Reporting such a great diversity, Ladd and Lipset (1975, p. 355) concluded that "we commonly find greater differences of opinion among the various scholarly disciplines than we can locate among the most grossly
differential groups in the general public such as rich and poor, young and old, and white and black."

While this study was designed to obtain information about the attitudes of faculty members toward alliances, it was not designed to categorize their attitudes into the liberal-conservative dichotomy as some studies have done. Bowen and Schuster (1986, p. 49), for instance, reported that the most liberal faculty members are those in social sciences, followed by those in the arts and natural sciences, and that the most conservative faculty members are found in applied professional fields. Rather, this study was drawn from the assumption of Nora and Olivas (1988, p. 129), that, while senior faculty members, especially in applied research fields, are most supportive of corporate-funded research, the faculty members in humanities and social sciences are more socially critical and less enthusiastic.

Summary

The problem, purpose, research questions, and basic assumptions of the study are presented in this chapter. A review of related literature on the evolution of university-industry alliances, typology of university-industry alliances, the philosophical bases of university-industry alliances, the extent of industrial funding of academic
research and development, and implications of alliances for institutions of higher education are provided in Chapter 2. Chapter 3 includes a description of the population of the study and the method for collection and treatment of data. Chapter 4 presents the findings of this investigation. The concluding chapter contains a summary and discussion of major findings, conclusions, and recommendations for further study.
CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

During the past 2 decades, university-industry alliances have gained an extraordinary amount of attention in government, academia, the business community, and even in the press. Quite often, literature in higher education has heralded university-industry alliances as a new phenomenon. In order to provide an adequate understanding of the explosion of contemporary university-industry alliances, it is appropriate in this chapter to survey their historical roots and growth. This review of the literature focuses on (a) the evolution of university-industry alliances, (b) federal government involvements in university-industry alliances, (c) typology of university-industry alliances, (d) the philosophical bases of university-industry alliances, (e) the extent of industrial funding of academic research and development, and (f) implications of alliances for institutions of higher education.

Evolution of University-Industry Alliances

Healy (1979, p. 281) Rainsford (1972), and scholars at the National Science Foundation (1982) pointed out that the research university, as it is conventionally known today, emerged in the last quarter of the 19th century as
the modern multinational corporation. The land-grant model of the research university, for instance, emerged in 1862 with the enactment of the Morrill Act. Even though the Morrill Act did not bring the university face-to-face with industry, its "purpose was sufficiently broad and general to include all the varied concepts of industrialists" (Ross 1942, p. 47).

Because there were virtually no federal grants for individual faculty research projects during this early period, with the exception of those in agriculturally related fields, the major sources of support for faculty research were industrial gifts and trust funds of the National Academy of Sciences. Major donors to the funds included the Andrew Carnegie Institute in Washington, founded in 1902; the J. Lawrence Smith Fund, founded in 1884 for the promotion of the study of meteoric bodies; and the Rockefeller Foundation (Lankford, 1987, p. 270; True, 1937).

Scholars at the National Science Foundation (1982, pp. 9-10) and May (1970, pp. 151-152) observed that the rapidly growing industrial laboratories in the early 20th century had created closer ties between industries and universities. According to the National Science Foundation scholars, with industrial research and development expenditures pyramiding to $212 million in 1927 nationally, many industrial laboratories had evidently become reliant on the sophisticated and advanced training of university scientists
and graduates. The founding of the industrially sponsored National Science Research Fund (NSRF) during this period was obviously another intentional move by industrialists to promote fundamental science and to bring universities and industries into partnerships. Under the leadership of its founder, George Ellery Hale, the National Research Council successfully raised $25 million for the NSRF through an intensive fundraising campaign in 1925. After this success, however, only AT&T, U.S. Steel, and two industrial associations—Electric Light and Iron & Steel—supported the NSRF (Geiger, 1988, pp. 337-338). "Corporate altruism," or reluctance to sponsor "openly published research that might assist . . . competitors," finally led to the demise of the NSRF (National Science Foundation, 1982, p. 11.).

Even though the NSRF was short-lived due to lack of support from industries, some industrial representatives frankly warned that industrial laboratories could suffer a setback without the assistance of university scientists. Frank B. Jewett (cited in National Science Foundation, 1982, p. 10) of Bell Laboratories succinctly conveyed that warning in his address to the American Association for the Advancement of Science in 1929:

Not only must [universities] advance the frontiers of knowledge at a rate commensurate with our demands for industrial advancement but they must, at the same time, develop the scientifically trained personnel required to carry on the work of the industries as well as to carry on their own work. It is a well-recognized fact that within recent years industry has made extremely
heavy demands upon the faculties of the universities by reason of their ability to offer greater monetary rewards, and frequently better facilities for research. We now find ourselves confronted with the need of increasing the bargaining powers of universities and the attractiveness of academic positions. In this matter the industries have a clear-cut obligation to the universities, an obligation which they cannot avoid without themselves being the chief sufferers. It is an obligation which rests upon all industries alike, for in the final analysis what benefits one industry, benefits the others. That thoughtful men suffers walks of life are coming to see the vital need of a proper coordination of the nation's scientific interests is a happy augury for the future. (National Science Foundation, 1982, p. 10)

Between 1900 and 1930, a constellation of research universities initiated either direct or indirect linkages with industry. Massachusetts Institute of Technology (MIT), the largest and wealthiest technological university in the U.S., had its electrical engineering program industrially funded from its inception. According to Geiger (1988, pp. 337-338), by 1908 MIT had begun contractual research in chemistry. Under the dynamic leadership of William Walker, a professor of chemistry, MIT attracted scores of chemical industries by developing a program that appealed to their commercial interests (National Science Foundation, 1982, p. 10).

In compliance with its symbol, Technology Plan, the Division of Industrial Cooperation Research was established to administer industrial contracts. The division raised MIT's research funds from $100,000 to $280,000 in 1929 (Geiger, 1988, p. 335). Omenn (1982, p. 50) also noted
MIT's research funds from $100,000 to $280,000 in 1929 (Geiger, 1988, p. 335). Omenn (1982, p. 50) also noted that, after World War II, MIT attracted more than 200 chemical industries. These initial successes of MIT, however, were punctuated by a number of reasons. First, in spite of the apparent successes, MIT's linkages with industry did not yield enough financial benefits to establish its own research facilities. Consequently, some leaders of the institute began to view linkages as sources of problems. Second, the Rockefeller Foundation, one of the chief financiers of basic research, declined MIT's request for research funds. As Geiger (p. 336) rightly observed, only the timely intervening of corporate trustees led by Gerald Swope of General Electric and Frank Jewett of AT&T saved MIT.

The linkages of the University of Illinois with industries have been described as a "network of connections" (National Science Foundation, 1982, p. 10) and a "web of contracts" (Kruytbosch, 1982, pp. 72-73). Under the leadership of Roger Adams, a professor of chemistry and chairman of the review committee of the Bureau of Chemistry and Soils (Department of Agriculture), the university expanded its chemistry department to become the producer of the largest number of doctoral graduates in the world (Genuth, 1987, p. 144; National Science Foundation, 1982, p. 10). The National Science Foundation has estimated that
chemical industries that formed research linkages with the university.

The Throop College of Technology was transformed to what today is California Institute of Technology (Cal Tech) in 1920 by the effort of George Ellery Hale, the founder of the National Science Council (Geiger, 1988, p. 337). Since the 1920s, Cal Tech has become one of the nation's strongest technology research institutions. One of its earliest contacts with industry was when the Southern California Edison Company donated a volt high-tension laboratory worth $1 million for the furtherance of Robert Milikan's research on electrons and to increase the company's capability in transmitting electric power to distant areas. Scholars at the National Science Foundation (1982, pp. 10-11) and Nelkin, Nelson, and Kiernan (1987, pp. 65-67) also noted that, diametrically opposed to MIT's and the University of Illinois' approach, Cal Tech directly solicited funds from philanthropic organizations and businesses in order to support what it coined "cooperative research on problems of fundamental scientific importance" (National Science Foundation, 1982, p. 11).

The extraordinary performance of science during World War II brought the academy and industry even closer. Rae (1979, pp. 249-268) and Noble (1986, preface) noted in their scholarly books that due to the performance of science during the war, many industrial leaders became eagerly
interested in basic science for commercial purposes. To
demonstrate this high hope, many corporate leaders
immediately expanded their research laboratories and in-
house production facilities, and drastically increased
consultantships and employment of university scientists. By
the late 1950s, however, many business leaders had lost
interest in basic science, in part because of its failure to
fulfill their profit expectations and, in part because of
the economic recession of that period. Consequently,
industrial funding of academic research and development
decreased and remained static until the 1970s (National

As corporate sponsorship of basic research declined,
federal government support for it grew with great rapidity.
In a monumental work, Bok (1981, pp. 29-30) aptly noted that
after 1950, the U.S. federal government began to support
university research and development with such magnitude that
it caused university-industry alliances to decline in
relevance and significance. In addition to its historic
endeavors to promote science, the federal government
established the National Science Foundation in 1950, an
organization that later became the catalyst for bringing
universities and industry together. Nevertheless, since the
1970s, relationships between universities and industry have
once again become popular as federal and state governments
have continued a systematic reduction of fiscal support for
university research and development for other competing social services.

Involvement of the Federal Government in University-Industry Alliances

In his research study, Reams (1984, pp. 40-41) noted that early efforts of the federal government to promote scientific research included the statutory creation of the Department of Agriculture (1862, 1889), the Coast Survey (1807, 1832), the National Institute for the Promotion of Science (1840), the establishment of the Smithsonian Institution (1846), the American Association for the Advancement of Science (1848), the National Academy of Sciences (1863), and the National Bureau of Standards (1901). Since the early part of the 20th century the federal government has accelerated its interest in applied research and has established a framework for university-industry alliances beginning with the Roosevelt administration, which created the National Defense Research Committee (NARC) in 1941. In 1942, President Roosevelt further expanded the NARC to the Office of Scientific Research and Development (Smith & Karlesky, 1977, p. 13).

Nevertheless, President Nixon's address to Congress in March 1972 has been applauded by many scholars as the evolution of contemporary university-industry relationships (National Science Foundation, 1982; Nay & Waller, 1979). In
his address, the president charged the National Science Foundation and the National Bureau of Standards to determine effective ways of stimulating non-Federal investment in research and development and of improving the application of research and development results. The experiments to be set up under this program are designed to test a variety of partnership arrangements among the various levels of government, private firms, and universities. They would include the exploration of new arrangements for cost-sharing, patent licensing, and research support, as well as the testing of incentives for industrial research associations. (President's Message to Congress on Science and Technology, 1972, n.p.)

The leadership of the National Science Foundation created the University-Industry Cooperative Research Center's Experiments and the Innovative Center's Experiments in 1973, and the University-Industry Cooperative Research Projects Program in 1978, in response to the president's message. The National Bureau of Standards also responded by inaugurating the Experimental Technology Incentives Program, which focused on policy issues. After a review of industrial innovative programs in 1978, the Nixon administration further enacted the Stevenson-Wydler Technology Act (1980), and the Antitrust Guide Concerning Research Joint Ventures (1980), by the Antitrust Division of the U.S. Department of Justice. Each of the legislations embodied the recommendations resulting from the innovative program's review (cited in National Science Foundation, 1983, pp. 6-10).
The Reagan administration brought a different flavor to university-industry alliances. Initially, the administration not only enhanced the popularity of corporate sponsorship of faculty research by cutting federal grants to higher education institutions, but it also distanced itself from university-industry alliances "by demanding a limited view of government intervention in the private sector" (National Science Foundation, 1983, p. 15). In 1981, however, the administration passed the Economic Recovery Tax Act, which provided incentives through tax credits and charitable deductions for industrial funding of university research and development. To foster university-industry relationships, both federal and state governments have catalyzed the creation of particular programs and provided seed money since the 1970s (Fairweather, 1989; Melchiori, 1984).

Typology of University-Industry Alliances

A small number of arbitrary classifications of university-industry alliances have been suggested by various researchers (Haller, 1984; National Science Foundation, 1982; Nelkin et al., 1987; Tatel & Guthrie, 1983). The lack of uniformity in these classifications can be attributed to two factors: (a) the number and variety of all alliances are unknown to authors and the factors establishing and constituting them as alliances vary, and (b) the motives and
modes for establishing alliances between university and industry are very complex.

Factors Determining Choice of Alliances Among Universities

How the leaders of a university and its academic disciplines perceive themselves, to a great extent, influences their choice of research interactions, motives, and modes. For example, researchers at the National Science Foundation (1982, p. 63) noted that a chemistry department that perceived itself as "basic research" oriented rejected industrially funded research in polymer chemistry it had considered "too applied." By stark contrast, researchers at the National Science Foundation further observed that engineering oriented universities are apt to develop "practical and applied" research programs to attract industrial sponsorship.

The influence of top administrators in determining the types, motives, and modes of universities' research agreements with business and industry also compounds the variety and complexity of university-industry alliances. As acknowledged by researchers at the National Science Foundation and in the literature, it is common knowledge on campuses today that the hiring of some top administrators is based primarily on their ability to foster university-industry alliances. Approximately 66% of the 340 major alliances studied by researchers at the National Science
Factors Determining Alliances Among Industries

As in universities, the motives, modes, and types of contractual agreements business and industry establish with colleges and universities vary largely in their sizes, traditions, and commercial interests. The National Science Foundation (1982) report revealed that about 50% of the Fortune 500 corporations spend between 2% and 6% of their annual sales on research and development or at least $100 million each on research and development annually. In sharp contrast, smaller businesses seldom fund academic research and development. To illustrate, out of the 287 university-industry partnerships studied by the National Science
Foundation in 1982, only one (0.35%) was funded by a smaller business. A smaller business is defined in this case as a business "with less than $10 million annual income" (p. 50). Traditionally, businesses that fall into this category participate in university-industry knowledge transfer research programs or specific problem-solving programs rather than funding academic research and development.

Modes of participating in university-industry research interaction among industries also vary greatly. Researchers at the National Science Foundation (1982, pp. 51-52) further observed that the chemical industry, which has the longest history of research connections with academia, has more propensity to sponsor academic research and development than does the aerospace industry, which is more sensitive to proprietary rights questions and chooses to restrict itself to consultantships with individual professors.

Based on these diversities, the definition of university-industry alliances by universities, what constitutes them, and the method of reporting funds received from industry are not only varied and confusing, but also make accurate classification of alliances difficult. The exact number of existing university-industry alliances is unknown; various studies suggest different numbers. Scholars in the National Science Foundation identified 340 major types of research agreements in 1982, and 475 in 1983.
These were classified into 3 groups and 12 subgroups (National Science Foundation, 1983, p. 68).

Researchers at Cornell University identified only 157 major types of research agreements (Haller, 1984). Tatel and Guthrie (1983) and Nelkin et al. (1987) did not provide any figures, but categorized all forms of alliances into three groups: (a) research joint ventures or partnerships, (b) research consortia, and (c) hybrids of consortia-independent contractors. Based on a study of New York University's Center for Science and Technology Policy, Melchiori (1984, p. 9) provided three categories: (a) general research support (gifts, equipment donations, and endowments); (b) cooperative support and knowledge transfer through institutional and personal interactions; and (c) formal technology transfer (industry parts, extension teaching, and research institutes).

Without providing details, Gluck (1987), in his doctoral dissertation, catalogued major alliances into five groups: (a) research university-industry relationships (UIRs); (b) service UIRs; (c) student and fellowship UIRs; (d) faculty interest UIRs; and (e) university interest UIRs. Although Gluck's classifications are those commonly found in biotechnology, they implicitly reflect the nature of the controversial debate on the effects of university-industry alliances on the governance and operations of higher education institutions.
1. Research UIRs are contractual agreements in which the industry provides financial resources, laboratory facilities, and equipment for the purpose of conducting research for the industry on the university campus.

2. Service UIRs are also contractual agreements in which academic departments provide consultation, scientific advice, and training of employees of private firms in exchange for financial compensation.

3. Student and fellowship UIRs, found at campuses, are contractual agreements in which private firms make financial resources directly available to students and postdoctoral fellows for the purpose of educational training.

4. Faculty interest UIRs, perhaps the most controversial, are contractual agreements in which faculty members hold equity and important positions such as vice president, scientific officer, and chief operating officer in private firms or businesses while still retaining their university jobs. Firms founded by single faculty members or groups of faculty members for the sole purpose of commercializing their research are a perfect example of faculty interest UIRs. One of the earliest practices of faculty interest UIRs has been traced to Samuel Parr of the University of Illinois' Chemistry faculty who founded his own instrument firm after he invented an instrument for testing the quality of bituminous coal (Thackray, 1982, pp. 201-211).
5. University interest UIRs, though less controversial than research UIRs, have raised some cardinal questions concerning the alleged "passive postures" of university administrators in adopting stern policies for curtailing faculty excesses in other types of university-industry relationships. In this case, university interest UIRs are legal entities established by the university for the primary purpose of facilitating the commercialization of research conducted by its faculty members. Two prominent examples are the Wisconsin Alumni Research Foundation at the University of Wisconsin and the Center for Biotechnology Research/Eugenics at the University of California.

Philosophical Bases for University-Industry Alliances

The Philosophy of the Federal Government

Like all post-industrial societies, the United States has had to struggle to overcome periodic economic recessions and the challenges of the unfolding information age--the quest for technological supremacy and commercial competition among Western nations and Japan. In its Report to the Nation (1983), the National Commission on Excellence in Education, clearly reflected the state of affairs of the American economy, industry, technology, and higher education:

Our nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by
competitors throughout the world. This report is concerned with only one of the many causes and dimensions of the problem, but it is one that undergirds American prosperity, security, and civility. We report to the American people that while we can take justifiable pride in what our schools and colleges have historically accomplished and contributed to the United States and the well-being of its people, the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation. What was unimaginable a generation ago has begun to occur—others are matching and surpassing our educational attainments. (p. 51)

Also, as reported in a special issue of Educational Record (McKenna [Ed.], 1987, pp. 59-60) when the Business-Higher Education Forum submitted its first report, America's Competitive Challenge: The Need for a National Response, to President Reagan in May 1983, it made recommendations in four important areas: (a) trade, (b) capital investment, (c) technological innovation, and (d) human resources. In response, the Reagan administration formed the Commission on Industrial Competitiveness, which submitted another report in January 1985. Among other things, the commission called for the strengthening and sharpening of America's scientific and technological resources.

In order to translate the recommendations of the forum and the findings of 17 other studies, President Reagan formed a coalition which consisted of the forum, the Northeast-Midwest Congressional Coalition, and the Congressional Clearinghouse on the Future. The coalition contended in its September 1986 report, An Action Agenda for
America's Competitiveness (cited in Educational Record [1987, p. 59]), that the federal government had not played its proper role in research and development, which the coalition said was an integral part of a competitive economy. Consequently, the coalition recommended that (a) the research and development infrastructure in higher education be upgraded or modernized and (b) the federal government ensure a quick transformation of scientific and technological ideas from "drawing boards to the marketplace" (p. 60). One of the four steps adopted to achieve these objectives was for the federal government to "increase joint technology-development ventures among business, academia, and government" (p. 60).

Clearly, the underlying philosophy for the involvement of the federal government is threefold: (a) to revamp the declining economy of the nation; (b) to enhance the competitiveness of the American industry; and (c) to salvage the deteriorating conditions of many colleges and universities, which some scholars contend were "overbuilt and overstuffed" in the plentiful years but now face a fiscal void (Emmert & Cross, 1989, p. 409; Eveslage, 1986,; Melchiori, 1984, pp. 6-7). In a recent study Emmert and Crow (1989, p. 420) estimated that the rehabilitation of classrooms, libraries, and research laboratories on campuses nation-wide could cost as much as $60 billion.
The Philosophy of Higher Education

Noble and Pfund (1980, p. 246) identified three major shifts in the funding sources of university research. The first shift began in the early decades of this century when, in response to a changing political and economic climate, elitist liberal arts colleges were transformed into research and training centers in order to respond to the needs of emerging electrical and chemical industries. The second shift extended from the 1940s to the 1960s, when universities' primary ties with industries were transferred to the federal government as universities became centers of contract research for military defense and other governmental agencies. The third shift supposedly began in the 1970s, when universities shifted their allegiance back to the private sector, especially to the petrochemical industry, "under the goad of grave financial problems and in an effort to escape from governmental red tape and scrutiny" (p. 246).

The reasons advanced by Noble and Pfund (1980), though noteworthy, appear to oversimplify the wide range of complex factors that influence universities to diversify their funding sources, particularly when the case histories of each university and extraneous factors espoused by other theories are taken into account. Understandably, Noble and Pfund evaluated university-industry alliances from a socialist perspective.
Considering the relevance of an institution's case history to its research orientation, researchers from the New York University Field Study Office surveyed and interviewed key university, government, and industrial administrators concerning the factors that most influenced their participation in university-industry alliances. As reported by the National Science Foundation (1982, pp. 35-36) and a comparable study by Melchiori (1984, pp. 8-10), most university administrators admitted that procuring funds for basic research, graduate training, and rehabilitation of research laboratories was a primary factor, but they also agreed that research connections with industry presented a challenge and opportunity to research problems that are cardinal to the urgent needs of the general public. Occasionally, universities must work with industry because certain federal grants or seed money for applied research are available only through joint efforts.

Aside from financial rewards, some scholars argue that higher education needs the business community. Perhaps, no one has espoused this argument more explicitly than Healy (1979). According to Healy, higher education inevitably needs the business community because it exerts influence in "forming the public mind and the public consciousness." He contended, therefore, that "any disaffection on its part with higher education has an impact on legislation and the ballot box and can substantially damage both public and
private higher education" (p. 272). For Healy, American citizenship implied the "art of making, selling, and trading known as enterprise," (p. 274) so to speak. He concluded that only the combined efforts of higher education and industry can adequately prepare students for the social responsibilities of American citizenship.

Extent of Industrial Funding of University Research and Development

As mentioned earlier in this study, methods of research interactions between individual universities and industries vary. Similarly, mediums of financial exchange vary. The major types of mediums commonly listed in the literature include (a) gifts—solicited and nonsolicited—such as equipment donations and discount on equipment purchases, (b) grants, (c) loans—for research infrastructure, (d) scholarship, and (e) personnel exchanges (Gluck, 1987; National Science Foundation, 1983, p. 12).

In addition to this short list, there are other mediums of exchange that are often not reported by universities or that are simply overlooked, even by scholarly studies. According to the National Science Foundation (1983, p. 23), the following factors make it difficult to quantitatively assess industrial funding of academic research and development. First, fragmentation of a data base and multiplicity of mediums of exchange create confusion. Second, most studies failed to account for (a) the
unwillingness of universities in reporting total research and development expenditures from businesses; (b) funds donated by corporations through foundations but reported by universities as being from non-profit sources; and (c) the fact that operating and capital funds for research infrastructure, faculty, and student fellows are seldom included.

From the sketchy and conflicting reports that are available, the extent of industrial funding of university research and development can be summarized in the following fashion: From 1960 to 1970, when industrial funding of university research declined, industrial funds accounted for between 3% and 4% of the total university research and development expenditures, or a drop from about 8% (before 1960) to 6% (between 1960 and 1965) in industrial budgets for university research (National Science Foundation, 1982, pp. 11-12). Between 1975 and 1981, however, industrial budget picked up from 6% to 12%.

Nelkin et al. (1987, p. 65) estimated industrial academic research and development expenditures in 1973 at $84 million. These amounts rose to $190.3 million (National Science Foundation, 1982, p. 12) or $194 million (Nelkin et al., 1987, p. 65) in 1979, and $235 million in 1980. Of the $190.3 million in 1979, $86.7 million was spent on research in engineering. The total academic research and development expenditures from all sources in 1981 have been estimated at
$6.6 billion in current dollars (National Science Foundation, 1982, p. 14). A breakdown of the expenditures showed that $4.4 billion went in support of basic research, $1.8 billion for applied research, and $0.4 billion for development. The amount contributed by industries out of the $6.6 billion was not reported by the National Science Foundation, but Gavert (1983, p. 25) and Peterson (1983, p. 76) recorded $240 million for industries. In 1983, industrial funding of academic research and development rose to $370 million.

Since the 1980s, university-industry alliances have been the fastest growing aspect of higher education; industrial funding of academic research and development has more than tripled. In a recent National Science Foundation report for fiscal year 1989, the top 100 research universities received $7.5 billion in U.S. funds from private sources, or a total of $12.3 billion from all sources for research and development. For all participating institutions in the nation, the National Science Foundation reported $9 billion from private sources, or a grand total of $15 billion from all sources for research and development. These figures represent only research and development in science and engineering, and do not include the amounts received by the arts, education, the humanities, law, and physical education (National Science Foundation, 1990).
The general impression is that, on the national average, only 4% to 5% of the total academic research and development expenditures are contributed by business and industry. However, the picture changes at state and institutional levels. For instance, the Texas Higher Education Coordinating board (1991, p. 5) reported all sources of funds for conduct of research and development in public institutions of higher education as follows: federal, $432 million or 50%; state, $197 million or 23%; private, $148 million or 17%; and institutions, $85 million or 10%.

Industrial funds represent a more significant percentage of academic research and development expenditures at the institutional level than at the national level, especially among major research universities. In 1983, a New York University study showed that half of the 200 research universities reported 15% of their research expenditures as private sources and the top 10 universities reported 25% (Cullinton, 1983, p. 150).

In 1986, Blumenthal, Gluck, Louis, Soto, and Wise (p. 1362) reported that biotechnology research universities received between 16% and 24% of their resources from biotechnology firms. At least 28 universities reported in 1988 that they derived more than 10% of their research funds from industry, compared to just 5% received in 1975 (Geiger, 1988, p. 341).
Ken Smith (cited in Latanision, 1984, p. 353), the vice president for research at MIT, reported in 1984 that industrial funding was growing faster than any source at his institution. According to Smith, industrial funds rose 20% annually between 1976 and 1984. In fiscal year 1986, industrial sources underwrote 15% (or $36 million) of MIT's research and development expenditures. At Carnegie-Mellon University, business and industry accounted for 23% of the university's $100 million annual research budget in 1989, according to Provost Angel Jordan (Emmert and Crow, 1989). Finally, out of 465 industrially funded research projects identified in a New York University study, 67% were in engineering and computer science and only 4% were in biotechnology (Cullinton, 1983, pp. 150-151).

Implications of University-Industry Alliances for Higher Education

Recent decades have witnessed the swift movement of universities from monolithic dependence on federal and state governments for financial support to a new role in technology based economy. This new trend, in the words of Ashby (1974, p. 11), signifies a "moving away from the monastic concept of Newman's university with its pursuit of knowledge irrespective of its utility." As quoted by Kerr almost a century and half ago, Cardinal Newman had defined a university as
the high protecting power of all knowledge and science, of fact and principle, of inquiry and discovery, of experiment and speculation; it maps out the territory of intellect, and sees that there is neither encroachment nor surrender of any side. (Kerr, 1972, p. 2)

In accordance with Newman's philosophy, university research has traditionally been directed toward the educational needs of the academic community and knowledge of practical problems (basic science), as opposed to development and commercialization of innovative inventions (applied science) (Giamatti, 1981, p. 119). The central roles of universities in the emergent technology-based economy inevitably demand the fusion of basic science and applied science and the formation of partnerships with the private sector.

The literature suggests that policymakers, scholars, and even industrial leaders worry about the implications of such partnerships for universities and tax-payers. Reams (1984) and Tatel and Guthrie (1983) found that partnerships have a multitude of legal implications for universities. Although Delgado and Leskovac (1987) and Kerr (1989) stressed the ethical implications, Kertz (1982-1983) pointed out the tax implications of university partnerships with the business world. Bok (1982) pointed out the following four dangers of alliances to academic science: (a) financial interests may dictate the choice of professors' research problems, (b) research in technological development may
become more important to professors than teaching tasks, (c) scientific investigation may turn secretive as opposed to the principle of openness, and (d) the public may lose respect and confidence in the academy if it finds professors compromising their reputations for disinterested investigation.

Other questions at hand concern whether universities can enter the marketplace without subverting their commitment to learning, and service to the taxpayers who invest in basic research. Can academic researchers enter into contracts with the business world without sacrificing their academic freedom? Blumenthal et al. (1986), Gluck (1987), Marver and Patton (1976), and Patton (1980), in empirical investigations, found no significant effects of these implications on universities. Commenting on the implications of university-industry alliances at the Pajaro Dunes Conference, Herbert I. Fusfield, director of policy at New York University concluded: "There are no absolutes, and the issue becomes one of degree and common sense" (Cullinton, 1983, p. 151).

One may ask: Are the implications real or merely perceived? Kerr, in his monumental work The Uses of the University (1972), was one of the earliest authors to note that in the 1960s when federal government support of university research reached its peak, federal monies brought tension between the humanists and scientists with the
humanists resenting the fact that scientists got promoted faster and had greater access to federal monies. In a recent research study, Nora and Olivas (1988) followed a conservative ideology, which proposes that faculty members in sciences and applied research fields (engineering, agriculture, medicine, pharmacy, etc.) are more supportive of industrially funded research but that "humanists and social scientists" are socially critical of it because of fewer opportunities for their participation and their higher views of the traditional roles of universities. In Chapter 4 of this study, an attempt is made to show the differences or similarities between the attitudes of faculty members in the applied research fields and faculty members in the applied arts and sciences, and their perceptions of the implications of university-industry alliances.

Summary

A review of the literature related to university-industry alliances is provided in this chapter. The review is focused principally on the evolution of alliances, the roles of federal and state governments in alliances, factors that influence the participation of universities as well as industry in alliances, the extent of industrial spending on academic research and development, and the implications of alliances for higher education institutions.
CHAPTER 3

RESEARCH METHODS AND PROCEDURES

Introduction

The central purpose of this study was to compare the attitudes of faculty members in applied science fields and faculty members in the arts toward the effects of university-industry alliances on the governance and operation of institutions of higher education. Secondary themes included (a) an appraisal of the debate on alliances and their effects on academic value and (b) a contribution to the literature concerning alliances and their potential for improving higher education.

Rationale for Using University of Texas at Dallas and University of North Texas for the Study

A number of factors make Texas, and the University of Texas at Dallas (UTD) and the University of North Texas (UNT) in particular, a fertile ground for university-industry alliances. During his testimony before the Texas Committee on Business, Technology, and Education in 1985, T. Stauffer (cited in Nora & Olivas, 1988, pp. 127-128) noted that business leaders across the nation perceive Texas as a probusiness state due to its political climate and tax structures. According to a 1980 article in Inc. Magazine and a study by B. Dorgan (1980), low tax rates and tax
abatements have traditionally played a fundamental role in site selection among industrial leaders.

In 1989, more than 80% of the Fortune 500 chief executives interviewed by Moran Stahl and Boyer, a consulting firm based in New York, indicated that they planned to relocate their plant offices, and 14% were in the process of relocating their headquarters (cited in Labich, 1989). In a subsequent study of the best cities for business in the nation, Dallas-Fort Worth were chosen as the best and most favorable cities. According to Dennis Donovan, vice president of the consulting firm, the two cities "have become the most diverse and dynamic economic base in the U.S., and it [Dallas/Fort Worth metroplex] has become a true national center, one that is extraordinarily rich in human resources" (pp. 56-57). The Dallas-Fort Worth area is popularly known as a metropolitan center or simply as the "metroplex." The Dallas-Fort Worth metroplex extends to nine counties, which include the locations of UTD and UNT.

Since 1979, the Dallas-Fort Worth metroplex has been one of the chief beneficiaries of corporations relocating from all parts of the country. For instance, in 1979 American Airlines relocated to the metroplex from New York. In more recent years, companies such as Exxon, J.C. Penney, and GTE Southwest, have relocated their headquarters to the Dallas-Fort Worth metroplex or other cities in Texas. While
Dallas has continued to grow tremendously in finance and service businesses, Fort Worth draws small manufacturers, distributors, and high-tech corporations through LTV and Texas Instruments. Some of these businesses, especially Texas Instruments, also play a significant role in higher education institutions in the metroplex, either through corporate largesse or through their employees who teach night classes (Labich, 1989, pp. 79-80).

Both UTD and UNT have established research connections with many of the businesses operating in the metroplex. Historically, the three founding fathers of Texas Instruments were among the pioneers of the creation of UTD. In 1989, the vice president of the company was appointed the pro tem associate dean of the newly established engineering school, which was also partly funded by Texas Instruments (Labich, 1989, p. 80). UNT research programs such as the laser physics labs, nuclear accelerator program, organometallic chemistry program, and genetic research have attracted the attention of businesses in the metroplex and nationally. Since 1986, the UNT Business School has maintained linkages with Texas Instruments, American Airlines, ARCO Oil and Gas, Burlington Northern Railroad, Caltex Petroleum, Central and Southwest Services, E-Systems, Electronic Data Systems, Ernst and Whinney, Lone Star Gas, GTE Southwest, Frito-Lay, Haggar Apparel, J. C. Penney, and other companies.
Finally, Nora and Olivas (1988, p. 127) observed that Texas has generally fared relatively poor in federal research and development funding and, therefore, has less reliance on federal research and development dollars. With the location of the proposed federally funded $8.2 billion Superconductor-Supercollider in Ellis County (in the Dallas-Fort Worth metroplex), however, many colleges and universities in Texas have doubled their efforts to increase research grants from the federal government and corporations that play highly visible roles in the consortium. In 1990, for instance, UTD’s research and development expenditures were estimated at $9.6 million, compared to $8 million in the previous year (University of Texas at Dallas, 1990). UNT also boosted its research and development expenditures from $15.2 million in 1989 to over $19.4 million in 1990 (University of North Texas, 1991).

It is important to emphasize that the purpose for the selection of the two institutions was not to show how their faculty members compared in their attitudes toward university-industrial alliances. Rather, as fast growing research institutions that are subject to some of the potential or real implications of university-industry alliances, it was hoped that knowledge obtained from this study would provide some generalizable answers to the questions raised by alliances.
Collection of Data

**Design of the Survey Instrument**

The instrument (Appendix A) used for this study was designed to obtain answers to research questions in the following areas: (a) administrative-operational functions of the university, (b) quality of instruction, (c) proprietary research—ethical and legal implications, (d) academic values, (e) faculty reward structures, and (f) the future of alliances. The review of literature indicates that the current debate concerning the effects of university-industry alliances basically revolves around these six areas of higher education institutions (Blumenthal et al., 1986; Fairweather, 1989; Gluck, 1987; Nora & Olivas, 1988).

The instrument is divided into two sections. The first section solicits background information about respondents. Bearing in mind the complexity of how faculty members perceive their talents, interests, and educational backgrounds, each respondent was requested to classify herself or himself as either (a) a liberal arts and sciences faculty or (b) an applied arts and sciences faculty. The second section consists of 40 items or statements regarding attitudes of faculty. This section uses a Likert-type measurement scale ranging from strongly agree to strongly disagree. Respondents were instructed to check the number
that indicated the degree to which they agreed or disagreed with each of the 40 attitude items. The Likert-type scale was used to allow subjects who were unfamiliar with the purpose of the study to respond with "no opinion."

Pilot Study

In order to determine the content validity of the instrument, a pilot study was conducted at UNT. Based on the suggestion of Borg and Gall (1983, p. 427), 20 faculty members were selected randomly in the applied sciences and liberal arts departments. The procedures for the pilot study were the same as those for the actual study. A cover letter (Appendix C), survey instrument (Appendix A), and a stamped self-addressed envelope were mailed to each of the selected faculty members. Seventy-five percent of the instruments were returned within the first week of mailing. Approximately 2 weeks, or 10 working days, after the first mailing, telephone contact or visitations were made to those who had not yet responded.

Because the purpose of the pilot study was to determine whether questions were stated realistically to obtain desired information and to check for any excessively difficult or ambiguous items (see Appendix B for Content Validity Guide), a space was provided for comments that could lead to improvement of the instrument. No changes were made to the instrument as a result of the comments,
which ranged from support for the study to requests for the abstract of the study. Faculty members who participated in the pilot study and the statistics obtained from their responses were not included in the actual study.

**Sample**

Faculty members at UTD and UNT in Denton were included in the study. One hundred twenty-five full-time faculty members were randomly selected from a total of 195 faculty members identified in applied sciences: biology, biomedical sciences, chemistry, engineering (computer science, electrical, and mechanical, etc.), and physics/material science. Also, 125 full-time faculty members were randomly drawn from a total of 340 full-time faculty members identified in liberal arts and sciences and others: business administration, economics, history, political science, psychology, and sociology. A total of 250 faculty members made up the sample of the study. Each was mailed a survey questionnaire.

**Procedures for Data Collection**

After content validity was ascertained, the survey instrument (Appendix A), cover letter (Appendix E), and stamped self-addressed envelope were mailed to the 250 faculty members at UTD and UNT in Denton. The cover letter (Appendix C) conveyed the purpose of the study, suggested
deadlines for return of the survey instrument, and requested the cooperation of the subjects.

In order to maximize the return rate of the survey instrument, the following guidelines were followed, as suggested by Borg and Gall (1983, p. 428) and Vockell (1983, p. 50): (a) all subjects were pre-contacted at least 1 week in advance of the mailing of the instrument. Each received a postcard (Appendix D) that identified the investigator, the purpose of the study, and a request for cooperation by responding accurately and promptly to the instrument. According to Borg and Gall and Vockell, the pre-contacting of subjects potentially increases response rate and reduces the possibility of subjects treating the instrument as junk mail; (b) a stamped self-addressed envelope was enclosed for the convenience of subjects; (c) each instrument was accompanied by a cover letter (Appendix C) that courteously asked for the subject's cooperation; (d) approximately a week after the established deadline those who had not yet responded were either contacted through telephone calls, personal visitation, or follow-up letters (Appendix F) which included a second survey instrument and stamped self-addressed envelope.
Treatment of Data

The survey instrument consists of two parts. Part I sought demographic data and Part II sought interval data. In order to compare the attitudes of the two groups of faculty members toward university-industry alliances, frequencies and percentages were calculated for the Part I and frequencies, percentages, and means were calculated for Part II. The means of the two groups were compared to determine if the differences between the two groups were significant.

Summary

The research methods and procedures used in this study are presented in this chapter. For the two groups compared in this study, a total of 250 full-time faculty members from UTD and UNT were selected using a random sampling method. The rationale for using the two institutions for the study ranged from their rapidly growing research capabilities, proximity to businesses in the Dallas-Fort Worth metroplex to the proliferation of businesses in the metroplex. After the survey instrument was validated through a pilot study, a copy of the 40-item survey instrument was mailed to each of the 250 randomly selected subjects. Statistics such as frequencies, percentages, mean scores and probabilities were calculated for each group and compared.
CHAPTER 4

ANALYSIS OF DATA

Introduction

Fundamentally, the theoretical framework of this research was drawn from the research hypothesis of Nora and Olivas (1988), which proposed that faculty members in sciences and applied research fields (engineering, agriculture, medicine, pharmacy, etc.) would be most supportive of industrial and defense research and that faculty members in humanities and social sciences would be less enthusiastic and socially critical of it. Nora and Olivas suggested that the attitudes of the latter groups of faculty members toward industrial and defense research are a result of the limited opportunity they have to participate and because of their "higher minded" view of the mission of the university and liberal learning, and how they perceive their roles in the training of students. In a similar research study, Ladd and Lipset (1975) claimed that engineering, medicine, and chemistry faculty members tend to align with conservative political ideas and are favorable to private firms.

This chapter includes analyses of the data collected from the 40-item survey completed and returned by the two groups of faculty members utilized for this research at the
University of Texas at Dallas (UTD) and University of North Texas (UNT) in Denton. From a population of 535 identified faculty members, 250 were randomly sampled. The selection of participants was based on their current appointments in the following academic departments: applied sciences—biological sciences, chemistry, computer sciences, engineering (electrical and mechanical), biomedical sciences, and physics/material sciences; liberal arts and others—humanities (history), social sciences (economics and political science), behavioral sciences (psychology and sociology), and professional schools and colleges such as business and education. The intent of this research was to compare the attitudes of the two groups of faculty members toward the effects of university-industry alliances on the operation and governance of higher education institutions. The scope of this research precludes defense research, because defense research does not typically constitute an alliance between higher education institutions and the federal government.

Prior to the mailing of the surveys, a pilot study was administered to 20 randomly selected faculty members at UNT. The guidelines outlined by Borg and Gail (1983, p. 247) were cautiously followed. The procedures for the pilot study were the same as those used for the actual study. A cover letter (Appendix C), survey (Appendix A), and stamped
self-addressed envelope were mailed to each participating faculty member. The purpose of the pilot study was to test the content validity of the survey instrument. Neither the faculty members who participated in the pilot study nor the data obtained from their responses are included in the analysis of data.

In order to maximize the return rate, the 250 faculty members selected were contacted approximately 1 week in advance of the mailing of the survey instrument. According to Borg and Gail (1983, p. 428) and Vockell (1983, p. 50), pre-contacting subjects potentially maximizes return rates by minimizing the possibility of subjects treating the survey instrument as junk mail. Each faculty member received a postcard (Appendix D) that identified the investigator and the study, and solicited his or her cooperation and accurate and prompt response to the survey. This process was followed by the mailing of the cover letter (Appendix E), survey instrument (Appendix A), and stamped self-addressed envelope to each participant for the actual study. Approximately 1 week after the established deadlines, nonrespondents were contacted by telephone calls, personal visits, or follow-up letters (Appendix E).

Respondents

Of the 250 faculty members surveyed, 146 (58.4%) returned the surveys. For faculty members in sciences and
applied research fields: 68 (54.4%) completed the surveys; 6 (4.8%) returned uncompleted surveys on the basis of inadequate information; 2 (1.6%) returned uncompleted surveys because of busy schedules; and 3 (2.4%) surveys were returned because the faculty members had transferred to other universities. For the liberal arts and others: 60 (48%) completed surveys; 9 (7.2%) returned uncompleted surveys on the basis of inadequate information; 3 (2.4%) surveys were returned because the faculty members had left; 2 (1.6%) were misclassified; 1 (.8%) faculty member chose not to participate; and 1 (.8%) faculty member was deceased. Useable surveys totalled 128 (51.2%). Data were statistically analyzed using t-tests. The Statistical Package for Social Sciences (SPSS/PC+) was used for computations. In compliance with assured confidentiality and anonymity, the analysis of data does not include specific references to the responses of any individual faculty members or institutions utilized in this study.

Background of Respondents

Background information about each respondent was collected. Each respondent was requested to indicate her or his academic discipline or department, classification as either a liberal arts and science person or an applied arts and science person, rank, highest degree earned, and experience in university-industry alliances. Background
data for faculty members in applied sciences are provided in Table 1.

Table 1

<table>
<thead>
<tr>
<th>Academic Disciplines or Departments</th>
<th>£</th>
<th>% (N=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic Disciplines or Departments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>15</td>
<td>22.1</td>
</tr>
<tr>
<td>Chemistry</td>
<td>14</td>
<td>20.6</td>
</tr>
<tr>
<td>Computer science</td>
<td>7</td>
<td>10.3</td>
</tr>
<tr>
<td>Engineering</td>
<td>4</td>
<td>5.9</td>
</tr>
<tr>
<td>Biomedical</td>
<td>18</td>
<td>26.5</td>
</tr>
<tr>
<td>Physics/materials science</td>
<td>10</td>
<td>14.7</td>
</tr>
<tr>
<td><strong>Self-Classification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liberal arts &amp; sciences</td>
<td>29</td>
<td>42.6</td>
</tr>
<tr>
<td>Applied arts &amp; sciences</td>
<td>22</td>
<td>47.1</td>
</tr>
<tr>
<td>No response</td>
<td>7</td>
<td>10.3</td>
</tr>
<tr>
<td><strong>Rank</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor</td>
<td>30</td>
<td>44.1</td>
</tr>
<tr>
<td>Associate professor</td>
<td>20</td>
<td>29.4</td>
</tr>
<tr>
<td>Assistant professor</td>
<td>17</td>
<td>25.0</td>
</tr>
<tr>
<td>Others (regent professor)</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Highest Degree</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctorate (Ph.D., Ed.D.)</td>
<td>67</td>
<td>98.5</td>
</tr>
<tr>
<td>Others (M.D.)</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Experience in Univ.-Ind. Alliances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>41</td>
<td>60.3</td>
</tr>
<tr>
<td>No</td>
<td>27</td>
<td>39.7</td>
</tr>
</tbody>
</table>
As the data in Table 1 indicate, the largest number of responses in the applied science group were from biomedical sciences. The least number were from engineering. Almost an equal number of respondents classified themselves as either liberal arts and science faculty or applied arts and science faculty. Most (44.1%) of the respondents were ranked as professors, and 98.5% held doctorate degrees. A majority (60.3%) of the group reported that they had some experience in university-industry alliances.

Similar background data were also sought from faculty members in fields categorized as liberal arts in this study. Data for this group are included in Table 2.

As shown by the data presented in Table 2, the largest number of respondents in the liberal arts group were from business administration, and the least number were from economics. Similar to the applied science group, almost an equal number of respondents in liberal arts classified themselves either as liberal arts and science faculty or applied arts and science faculty. All respondents held doctorate degrees, and 45.8% were ranked as professors. Contrary to the experience of applied science faculty in university-industry alliances, only one-third (33.3%) of the liberal arts faculty members reported that they had experience in alliances.
Table 2

<table>
<thead>
<tr>
<th>Academic Disciplines or Departments</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>20</td>
<td>33.3</td>
</tr>
<tr>
<td>Economics</td>
<td>2</td>
<td>3.3</td>
</tr>
<tr>
<td>Education</td>
<td>10</td>
<td>16.7</td>
</tr>
<tr>
<td>History</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td>Political Science</td>
<td>8</td>
<td>13.3</td>
</tr>
<tr>
<td>Psychology</td>
<td>7</td>
<td>11.7</td>
</tr>
<tr>
<td>Sociology</td>
<td>5</td>
<td>8.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Self-Classification</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liberal arts &amp; sciences</td>
<td>25</td>
<td>41.7</td>
</tr>
<tr>
<td>Applied arts &amp; sciences</td>
<td>26</td>
<td>43.4</td>
</tr>
<tr>
<td>No response</td>
<td>9</td>
<td>15.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>27</td>
<td>45.8</td>
</tr>
<tr>
<td>Associate professor</td>
<td>19</td>
<td>32.2</td>
</tr>
<tr>
<td>Assistant professor</td>
<td>12</td>
<td>20.3</td>
</tr>
<tr>
<td>Others (regent professor)</td>
<td>1</td>
<td>1.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest Degree</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctorate (Ph.D., Ed.D.)</td>
<td>60</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experience in Univ.-Ind. Alliances</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>20</td>
<td>33.3</td>
</tr>
<tr>
<td>No</td>
<td>39</td>
<td>66.1</td>
</tr>
</tbody>
</table>

Effects of University-Industry Alliances on the Operational and Administrative Functions of the University

Research question one addressed similarities and differences in the opinions of faculty members in the
applied sciences and faculty members in liberal arts and others on the effects of alliances on certain aspects of the operations and administration of the university. In order to achieve this purpose, faculty members were asked to express opinions on the possibility that (a) alliances pose a risk to the missions and agendas of the university, (b) the autonomy of the university is insecure under alliances, (c) alliances disrupt the traditional lines of administrative controls of the university, (d) consulting does not harm the commitment of consulting faculty members to university activities, (e) their current institutions' consulting policies effectively prevent consulting faculty from compromising academic values with businesses, (f) alliances enhance the image of their university, (g) alliances have helped to improve or stabilize the fiscal conditions of their institutions, and (h) administrators passively handled allegations of abuses of alliances. Table 3 contains the frequency, percentage, mean scores, and probability for data related to research question one. The details of the t-test for the two groups are reported in Appendix G.

The data presented in Table 3 show that the two groups of faculty members were significantly different in their responses at the .05 level on two and at the .01 level on another two of the selected eight aspects of the operational and administrative functions of the university. Total
Table 3

Perceptions of Applied Sciences Faculty and Liberal Arts Faculty Concerning the Possibility that Alliances have Effects on the Missions, Autonomy, Lines of Administrative Control, Institutional Consulting Policies, Image, Fiscal Stability of the University, and Administrative Handling of Allegations of Abuse of Alliances

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Group</th>
<th>N</th>
<th>1-SA</th>
<th>2-A</th>
<th>3-No</th>
<th>4-D</th>
<th>5-SD</th>
<th>Mean</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliances threaten university's missions</td>
<td>1</td>
<td>68</td>
<td>4</td>
<td>16</td>
<td>6</td>
<td>23</td>
<td>19</td>
<td>3.5441</td>
<td>.086</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>3</td>
<td>25</td>
<td>3</td>
<td>18</td>
<td>11</td>
<td>3.1500</td>
<td>**</td>
</tr>
<tr>
<td>University's autonomy is secure under alliances</td>
<td>1</td>
<td>68</td>
<td>18</td>
<td>24</td>
<td>10</td>
<td>12</td>
<td>4</td>
<td>2.4118</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>9</td>
<td>18</td>
<td>6</td>
<td>26</td>
<td>1</td>
<td>2.8667</td>
<td>*</td>
</tr>
<tr>
<td>Alliances disrupt lines of administrative control</td>
<td>1</td>
<td>68</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>33</td>
<td>19</td>
<td>3.8676</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>59</td>
<td>2</td>
<td>16</td>
<td>7</td>
<td>24</td>
<td>10</td>
<td>3.4068</td>
<td>*</td>
</tr>
<tr>
<td>Consulting does not harm faculty commitment</td>
<td>1</td>
<td>68</td>
<td>16</td>
<td>31</td>
<td>11</td>
<td>5</td>
<td>5</td>
<td>2.2941</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>58</td>
<td>17</td>
<td>20</td>
<td>7</td>
<td>19</td>
<td>1</td>
<td>2.6379</td>
<td>**</td>
</tr>
<tr>
<td>Consulting policy protects academic values</td>
<td>1</td>
<td>68</td>
<td>10</td>
<td>25</td>
<td>18</td>
<td>10</td>
<td>5</td>
<td>2.6326</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>4</td>
<td>18</td>
<td>17</td>
<td>20</td>
<td>1</td>
<td>2.9333</td>
<td></td>
</tr>
<tr>
<td>Alliances enhance the image of university</td>
<td>1</td>
<td>68</td>
<td>21</td>
<td>35</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>2.0000</td>
<td>.673</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>20</td>
<td>33</td>
<td>7</td>
<td>3</td>
<td>-</td>
<td>1.9333</td>
<td></td>
</tr>
<tr>
<td>Alliances contribute to fiscal stability of university</td>
<td>1</td>
<td>68</td>
<td>14</td>
<td>27</td>
<td>17</td>
<td>9</td>
<td>1</td>
<td>2.3529</td>
<td>.554</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>11</td>
<td>31</td>
<td>12</td>
<td>4</td>
<td>2</td>
<td>2.2500</td>
<td></td>
</tr>
<tr>
<td>Administrators passively handle allegations of abuse of</td>
<td>1</td>
<td>68</td>
<td>5</td>
<td>19</td>
<td>28</td>
<td>12</td>
<td>4</td>
<td>2.8676</td>
<td>.570</td>
</tr>
<tr>
<td>alliances</td>
<td>2</td>
<td>59</td>
<td>1</td>
<td>21</td>
<td>27</td>
<td>10</td>
<td>-</td>
<td>2.7797</td>
<td></td>
</tr>
</tbody>
</table>

*Denotes significance at the .05 level
**Denotes significance at the .01 level

Group 1: Applied Sciences Faculty
Group 2: Liberal Arts Faculty and Other Faculty
Key: SA-Strongly Agree, A-Agree, NO-No Opinion, D-Disagree, SD-Strongly Disagree
percentages of strongly agree/agree and strongly disagree/disagree of responses are reported for each group.

At the .05 level, the two groups differed significantly in their responses with regard to the security of the autonomy of the university under alliances and with regard to the possibility that alliances disrupted the lines of administrative control of the university. A majority (61.8%) of applied science faculty reported that a university's autonomy is secure under alliances. In liberal arts, 45% responded as the applied science group but an equal number (45%) disagreed. Also, 73.9% of the applied science faculty reported that alliances do not disrupt lines of administrative control of a university, while only 57.6% of the liberal arts faculty reported the same.

At the .01 level, the two groups differed considerably in their responses concerning the possibility that alliances pose risks to the missions and agendas of the university and concerning the commitment of consulting faculty to activities that are crucial to the health of the university. Sixty-one percent of the applied science faculty, compared to only 48.3% of the liberal arts faculty disagreed that alliances pose a risk to the missions and agendas of the university. Also, in applied science, 69.1% reported that alliances do not harm the commitment of consulting faculty to university activities while only 53.5% of the liberal arts faculty reported the same.
No significant statistical differences were found between the responses of the two groups concerning the effectiveness of their institutional consulting policies in preventing consulting faculty from compromising academic values in pursuit of research monies, the possibility that alliances enhance the image of their universities, and the possibility that alliances contribute to the fiscal stability of their respective universities. Although most of the faculty in both groups abstained from expressing opinions concerning how administrators often handle allegations of abuse of alliances by consulting faculty, 35.3% of the applied science faculty and 37.3% of the liberal arts faculty reported that administrators often act passively in handling allegations of abuse of alliances by consulting faculty.

Effects of University-Industry Alliances on Quality of Scholarship and Instruction

Research question two addressed the effects of university-industry alliances on the quality of scholarship that consulting faculty have freedom to demonstrate under alliances, and the quality of instruction received by their students. In order to determine differences and similarities between the attitudes of applied science faculty and liberal arts and other faculty toward the effects of alliances on quality of scholarship and instruction, faculty members were asked to respond to the
claims of critics of alliances that proprietary research inhibits collegial discussion of research projects and the claims of proponents that corporate funds attract and retain quality faculty members to the university. Data were also sought in an attempt to determine if there was a shift in the commitment of consulting faculty members from basic research to research with commercial value, whether alliances encourage consulting faculty members to do classified research in order to protect trade secrets or the competitive advantage of private firms, whether experiences from participating in alliances improve the quality of instruction that students receive, and the extent to which faculty members participating in alliances allow their peers to review their research. The frequency and percentage distributions for data collected to answer research question two are presented in Table 4.

Of the six dependent variables that constituted research question two, which was focused on the quality of the scholarly works of consulting faculty in alliances and the effects of alliances on the quality of instruction that students receive, the two groups of faculty members were statistically different in their responses at the .05 level on two and at the .01 level on one. The total percentages for strongly agree/agree and strongly disagree/disagree are reported.
Table 4

**Perceptions of Applied Sciences Faculty and Liberal Arts Faculty Concerning the Possibility that Alliances Affect Collegial Relationships, Quality of Faculty, Research Choice, Openness in Research, Quality of Instruction, and Peer Review of Research Findings**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Group</th>
<th>N</th>
<th>1-SA f(%)</th>
<th>2-A f(%)</th>
<th>3-NO f(%)</th>
<th>4-D f(%)</th>
<th>5-SD f(%)</th>
<th>Mean Scores</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliances inhibit collegiate discussion of research</td>
<td>1</td>
<td>68</td>
<td>(7.4)</td>
<td>(25.0)</td>
<td>(16.2)</td>
<td>(33.8)</td>
<td>(17.6)</td>
<td>3.2941</td>
<td>.139</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>(6.7)</td>
<td>(38.3)</td>
<td>(8.3)</td>
<td>(43.4)</td>
<td>(3.3)</td>
<td>2.9833</td>
<td></td>
</tr>
<tr>
<td>Corporate funds attract and retain quality faculty</td>
<td>1</td>
<td>68</td>
<td>15 (22.1)</td>
<td>34 (50.0)</td>
<td>8 (11.8)</td>
<td>9 (13.2)</td>
<td>2 (2.9)</td>
<td>2.2500</td>
<td>.158</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>15 (25.0)</td>
<td>33 (55.0)</td>
<td>8 (13.3)</td>
<td>4 (6.7)</td>
<td>-</td>
<td>2.0167</td>
<td></td>
</tr>
<tr>
<td>Consulting faculty favor commercial research over basic research</td>
<td>1</td>
<td>68</td>
<td>(11.8)</td>
<td>(26.5)</td>
<td>(19.1)</td>
<td>(29.4)</td>
<td>(13.2)</td>
<td>3.0588</td>
<td>.008</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>(6.7)</td>
<td>(48.3)</td>
<td>(28.3)</td>
<td>(16.7)</td>
<td>-</td>
<td>2.5500</td>
<td>*</td>
</tr>
<tr>
<td>Alliances encourage classified research</td>
<td>1</td>
<td>68</td>
<td>(7.4)</td>
<td>(29.4)</td>
<td>(14.7)</td>
<td>(38.2)</td>
<td>(10.3)</td>
<td>3.1471</td>
<td>.094</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>(6.7)</td>
<td>(38.3)</td>
<td>(25.0)</td>
<td>(26.7)</td>
<td>(3.3)</td>
<td>2.8167</td>
<td>**</td>
</tr>
<tr>
<td>Alliances improve quality of instruction</td>
<td>1</td>
<td>68</td>
<td>(16.2)</td>
<td>(39.7)</td>
<td>(17.6)</td>
<td>(17.6)</td>
<td>(8.8)</td>
<td>2.6324</td>
<td>.426</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>(20.0)</td>
<td>(40.0)</td>
<td>(16.7)</td>
<td>(20.0)</td>
<td>(3.3)</td>
<td>2.4667</td>
<td></td>
</tr>
<tr>
<td>Alliances do not threaten peer review of research</td>
<td>1</td>
<td>68</td>
<td>(19.1)</td>
<td>(39.7)</td>
<td>(19.1)</td>
<td>(20.6)</td>
<td>(1.5)</td>
<td>2.4559</td>
<td>.028</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>(1.7)</td>
<td>(41.7)</td>
<td>(30.0)</td>
<td>(23.3)</td>
<td>(3.3)</td>
<td>2.8500</td>
<td>*</td>
</tr>
</tbody>
</table>

*Denotes significance at the .05 level
**Denotes significance at the .01 level

Group 1: Applied Sciences Faculty
Group 2: Liberal Arts Faculty and Other Faculty

Key: SA-Strongly Agree, A-Agree, NO-No Opinion, D-Disagree, SD-Strongly Disagree

The two groups of faculty were significantly different at the .05 level with respect to the choice of research problems among consulting faculty and concerning the
possibility that alliances threaten peer review of faculty research. For instance, 55.0% of the liberal arts faculty reported that consulting faculty had become more interested in research with commercial value than basic research. On the contrary, 42.6% of the applied science faculty disagreed. Fifty-eight percent of the applied science faculty, compared to only 43.4% of the liberal arts faculty, reported that alliances did not threaten peer review of faculty research.

The two groups differed considerably in their responses at the .01 level concerning the view of some scholars that alliances encourage classified research, as opposed to the academic tradition of openness. As the data indicate, 48.5% of the applied science faculty disagreed with the view, but 45% of the liberal arts faculty agreed with it.

No significant difference was evident in the responses of the two groups concerning the possibility that alliances inhibit collegial discussion of research projects and collegial relationships; 51.4% in applied science and 46.7% in liberal arts reported that alliances do not inhibit either collegial discussion of research or collegial relationship. The majority of the two groups, 50.0% in applied science and 55.0% in liberal arts, also reported that corporate funds attract and retain quality faculty. With respect to the possibility that alliances contribute to the fiscal stability of their universities, 55.9% of the
applied science faculty and 60.0% of the liberal arts faculty reported in the affirmative.

The Magnitude of Ethical Abuses of Alliances as Estimated by Applied Sciences Faculty and Liberal Arts Faculty

The central purpose of research question three was to determine the perceptions of applied science faculty and liberal arts and other faculty on the view that some consulting faculty professionally and ethically abuse their research connections with private firms. Faculty opinions were sought on the claims of critics that conflict of interest has become widespread and that the number of consulting faculty holding equity or important positions in the private companies where they have consultantships is significant enough to cause concern among university administrators.

Faculty opinions were also sought concerning whether or not consulting faculty should be required to declare their interest and the magnitude of such interest in private companies, especially if they receive funds for research from such companies. Because the amount of time consulting faculty members spend on corporate research has become a fundamental factor in the controversial debate about the effects of alliances on higher education institutions, faculty were asked to indicate whether consulting time is competitive with university activities, whether consulting
faculty devote more time to corporate research than teaching, and whether or not state government should regulate research contracts between faculty scientists and private companies. The frequency and percentage distributions, group mean scores, and probabilities for data collected to answer research question three are displayed in Table 5.

As shown by the data in Table 5, the two groups were significantly different in their responses at the .05 level in two major areas concerning alleged ethical abuse of alliances by consulting faculty, which is the focus of the third research question. Total percentages of strongly agree/agree and strongly disagree/disagree responses are reported for each group.

The first area of difference was in the perceived competitiveness between consulting time and university activities. While 70.0% of the liberal arts faculty considered consulting to be time-consuming and competitive with university activities, the applied science faculty were equally divided (44.1% to 44.1%) on the numbers who agreed and who disagreed. Conversely, 44.1% of the applied science faculty reported that consulting faculty devote more time to students than proprietary research, but 33.4% of the liberal arts faculty reported the contrary.

No significant statistical difference was found in the two groups' estimates of the magnitude of alleged ethical
Table 5

Faculty Estimates of the Magnitude of Conflict of Interest, Equity Holding, Amount of Time Devoted to Consulting Compared to Amount of Time Spent with Students by Consulting Faculty, and the Possibility of State Involvement in Policy Design for Consulting

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Group</th>
<th>N</th>
<th>1-SA</th>
<th>2-A</th>
<th>3-NO</th>
<th>4-D</th>
<th>5-SD</th>
<th>Mean Scores</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conflict of interest is widespread in universities</td>
<td>1</td>
<td>68</td>
<td>1</td>
<td>3</td>
<td>21</td>
<td>29</td>
<td>14</td>
<td>3.7647</td>
<td>.102</td>
</tr>
<tr>
<td>Consulting faculty holding equity are numerous</td>
<td>2</td>
<td>60</td>
<td>1</td>
<td>6</td>
<td>17</td>
<td>33</td>
<td>3</td>
<td>3.5167</td>
<td></td>
</tr>
<tr>
<td>Consulting faculty should not declare interest in sponsoring industry with university activities</td>
<td>1</td>
<td>68</td>
<td>7</td>
<td>13</td>
<td>12</td>
<td>22</td>
<td>14</td>
<td>3.3382</td>
<td>.997</td>
</tr>
<tr>
<td>Consulting faculty spend more time with students than proprietary research</td>
<td>2</td>
<td>60</td>
<td>9</td>
<td>21</td>
<td>20</td>
<td>16</td>
<td>2</td>
<td>2.7206</td>
<td>.011</td>
</tr>
<tr>
<td>State should be involved in policy design for research</td>
<td>1</td>
<td>68</td>
<td>8</td>
<td>13</td>
<td>5</td>
<td>29</td>
<td>13</td>
<td>3.3824</td>
<td>.996</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>3</td>
<td>13</td>
<td>10</td>
<td>26</td>
<td>8</td>
<td>3.3833</td>
<td></td>
</tr>
</tbody>
</table>

*Denotes significance at the .05 level

Group 1: Applied Sciences Faculty
Group 2: Liberal Arts Faculty and Other Faculty
Key: SA-Strongly Agree, A-Agree, NO-No Opinion, D-Disagree, SD-Strongly Disagree
violation, such as conflict of interest in research, holding of equity, or important positions in private companies, especially where consulting faculty received research grants. In addition, no statistical difference was found in the two groups' opinions concerning the need for consulting faculty to declare financial interest or other interests, if any, in private companies. Both groups also rejected the recommendation by some scholars that state governments should be involved in the process of setting policy for consulting between faculty scientists and businesses in order to protect the investment of taxpayers in basic research.

Effects of University-Industry Alliances on Academic Freedom of Consulting Faculty Members

The fourth research question addressed the degree of conflict between academic freedom and contractual agreements in the perceptions of applied science faculty and liberal arts and other faculty. In order to answer this question, subjects were asked to estimate the amount of restriction that industry funds versus federal and state funds for research impose on consulting faculty members. Subjects were also questioned on the controversial debate concerning the duration that a consulting faculty member may withhold research findings for publication to protect trade secrets and profit advantage of the sponsoring industry.
While some businesses allow faculty scientists to publish their research, they prohibit specific references to their research projects. An attempt was made to obtain faculties' responses to such prohibition and to research agreements that influence consulting faculty members to become secretive about research projects. Faculty were also queried about the claim of proponents of alliances that consulting faculty members accrue skill and experience that enable them to publish more prolifically than nonconsultants. Other important issues on which data were sought included whether the university or industry should have the exclusive rights to patents resulting from joint research and whether or not consulting faculty should teach research findings to students regardless of the opinions of business leaders. Frequency and percentage distributions for faculty responses to these questions are included in Table 6.

Applied sciences faculty and liberal arts faculty were significantly different in their responses at the .05 level on three of the seven dependent variables that formed research question four. Research question four addressed the amount of intellectual freedom that consulting faculty have under contractual agreements. Total percentages of strongly agree/agree and strongly disagree/disagree responses are reported for each group.
Table 6

Responses of Applied Sciences Faculty and Liberal Arts Faculty Concerning the Amount of Restrictions that Contractual Agreements in Research Impose on Their Freedom to Publish, Discuss Research with Colleagues and Teach Findings to Students

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Group</th>
<th>N</th>
<th>1-SA f(%)</th>
<th>2-A f(%)</th>
<th>3-NO f(%)</th>
<th>4-D f(%)</th>
<th>5-SD f(%)</th>
<th>Mean Scores</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporations attach more &quot;strings&quot; to funds than does federal government</td>
<td>1</td>
<td>68</td>
<td>27 (13.2)</td>
<td>12 (17.6)</td>
<td>11 (16.2)</td>
<td>9 (13.2)</td>
<td>9 (13.2)</td>
<td>2.7647</td>
<td>.063</td>
</tr>
<tr>
<td>Corporations should hold ownership of research for three months</td>
<td>1</td>
<td>68</td>
<td>20 (7.4)</td>
<td>16 (29.4)</td>
<td>14 (29.4)</td>
<td>12 (13.2)</td>
<td>9 (13.2)</td>
<td>3.2059</td>
<td>.033</td>
</tr>
<tr>
<td>Consulting faculty are basically secretive about research</td>
<td>1</td>
<td>68</td>
<td>17 (29.4)</td>
<td>14 (29.4)</td>
<td>13 (29.4)</td>
<td>12 (13.2)</td>
<td>9 (13.2)</td>
<td>3.2353</td>
<td>.008</td>
</tr>
<tr>
<td>Faculty to avoid reference to proprietary research in publication</td>
<td>1</td>
<td>68</td>
<td>22 (5.9)</td>
<td>22 (32.4)</td>
<td>22 (32.4)</td>
<td>16 (23.5)</td>
<td>16 (5.9)</td>
<td>2.9118</td>
<td>.248</td>
</tr>
<tr>
<td>Consulting faculty publish more than non-consultants</td>
<td>1</td>
<td>68</td>
<td>28 (7.4)</td>
<td>26 (23.5)</td>
<td>24 (41.2)</td>
<td>19 (19.1)</td>
<td>13 (8.8)</td>
<td>3.2059</td>
<td>.065</td>
</tr>
<tr>
<td>All rights to patents should belong to the university</td>
<td>1</td>
<td>68</td>
<td>8 (1.5)</td>
<td>8 (15.2)</td>
<td>8 (11.8)</td>
<td>7 (52.9)</td>
<td>6 (20.6)</td>
<td>3.7794</td>
<td>.084</td>
</tr>
<tr>
<td>Proprietary research should be taught to students</td>
<td>1</td>
<td>68</td>
<td>13 (8.8)</td>
<td>13 (27.9)</td>
<td>13 (19.1)</td>
<td>10 (30.9)</td>
<td>9 (13.2)</td>
<td>3.1176</td>
<td>.006</td>
</tr>
</tbody>
</table>

*Denotes significance at the .05 level  
**Denotes significance at the .01 level

Group 1: Applied Sciences Faculty  
Group 2: Liberal Arts Faculty and Other Faculty  
Key: SA—Strongly Agree, A—Agree, NO—No Opinion, D—Disagree, SD—Strongly Disagree
Study of the data in Table 6 reveals a significant difference in the responses of the two groups with regard to the suggestion by scholars that the sponsoring industry should hold ownership of research findings no longer than three months to protect its profit advantage in order to allow consulting faculty the freedom to publish research findings without undue delay. In applied science, 42.6% of the faculty objected to the suggested 3-month duration but 32.8% of the liberal arts faculty were in favor of the 3-month duration.

The two groups also differed significantly in their responses concerning the general perception that consulting faculty basically have a tendency to be secretive about proprietary research due to certain contractual agreements. Most (45.6%) of the applied science faculty and 37.3% of the liberal arts faculty reported that consulting faculty do not have a tendency to be secretive about research under contractual agreements. Similarly, the two groups differed significantly in their responses to the controversial debate on whether consulting faculty could teach discoveries from proprietary research to students. A majority (63.8%) of the liberal arts faculty reported that such innovative discoveries should be taught to students regardless of the opinion of business leaders, but 44.1% of the applied science faculty disagreed with the proposition.
Although the two groups were not significantly different at the .05 level, they differed statistically at the .01 level with respect to the amount of restrictions that corporations attach to research grants compared to federal and state governments, and concerning the issue of exclusive rights to patents resulting from alliances. More than half, 52.9%, of the applied science faculty reported that corporations attach more conditions to research grants than do federal or state governments, but 40.0% of the liberal arts faculty reported that federal and state governments attach more conditions than do corporations. Also, 73.5% of the applied science faculty, compared to 56.0% of the liberal arts faculty, reported that a university should not have exclusive rights to patents resulting from alliances.

No significant difference was found in the responses of the two groups concerning the corporate requirement that consulting faculty should avoid direct reference to proprietary research in publication. Also, no significant statistical difference was found between the two groups concerning the much-debated view that consulting faculty have the edge over nonconsultants in publishing. There appeared to be no one popular opinion between the two groups.
Effects of University-Alliances on Faculty Reward Structures

Research question five addressed the measurement of the effects of alliances on faculty reward structures as perceived by faculty members in applied sciences versus faculty members in liberal arts and other fields. In order to answer this question faculty members were asked to respond to criteria (traditionally, teaching, basic research, and service) that should apply to salary increase and promotion decisions, whether salary differentials could be attributed to preferential treatment of faculty members who have more opportunity to be involved in university-industry alliances, and whether they would like their administrators to encourage consulting for extra income in order to reduce faculty pressure for salary increases. Responses were also sought concerning which factor has the most influence on administrators' promotion and tenure decisions.

As an alternative to, or in combination with, university-industry alliances, a small number of research universities have established centers that selectively commercialize faculty research. A second objective of research question five was to determine whether faculty members favor such institutional centers and if they consider it appropriate for their universities to establish one. Faculty were also queried concerning the claim of some
critics that alliances have the potential to alter traditional standards of promotion and salary adjustments. Additionally, respondents' opinions on faculty interest in participating in alliances for additional income were solicited. Data collected to answer research question five are exhibited in Table 7.

Of the seven dependent variables that formed the fifth research question, the two groups of faculty were significantly different in their responses at the .05 level on two, and significantly different at the .01 level on one. Total percentages of strongly agree/agree and strongly disagree/disagree are reported for each group.

As indicated by the data in Table 7, the responses of applied science faculty significantly differed from the responses of liberal arts faculty concerning the claim of some scholars that alliances can alter the conventional standards of promotion and tenure in favor of consulting faculty members. A majority (57.4%) of the applied sciences faculty disagreed with the view, but 38.3% of the liberal arts faculty agreed. A significant difference also existed between the levels of their optimism for involvement in alliances for additional income. In applied sciences, 80.9% of the faculty welcomed the opportunity, compared to 61.7% in liberal arts.
Table 7

Responses of Applied Sciences Faculty and Liberal Arts Faculty Concerning the Possibility that Alliances Could Alter the Basis for Salary Increase, Promotion, Tenure, Research Incentives, and Possibility of Establishing Centers for Commercialization of Faculty Research, and Opportunity for Involvement in Alliances for Extra Income

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Group</th>
<th>N</th>
<th>1-SA f(%)</th>
<th>2-A f(%)</th>
<th>3-NO f(%)</th>
<th>4-D f(%)</th>
<th>5-SD f(%)</th>
<th>Mean Scores</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotion should be based on teaching and basic research</td>
<td>1</td>
<td>68</td>
<td>(42.6)</td>
<td>(39.7)</td>
<td>-</td>
<td>10</td>
<td>2</td>
<td>1.9559</td>
<td>.498</td>
</tr>
<tr>
<td>Consulting faculty are somehow overly compensated</td>
<td>1</td>
<td>68</td>
<td>(2.9)</td>
<td>(11.8)</td>
<td>(29.6)</td>
<td>(41.2)</td>
<td>(14.7)</td>
<td>3.5000</td>
<td>.420</td>
</tr>
<tr>
<td>Consulting for extra income will reduce pressure for salary increase</td>
<td>1</td>
<td>68</td>
<td>(4.9)</td>
<td>(19.1)</td>
<td>(23.5)</td>
<td>(38.2)</td>
<td>(13.2)</td>
<td>3.3832</td>
<td>.445</td>
</tr>
<tr>
<td>Research takes precedence over teaching and services</td>
<td>1</td>
<td>68</td>
<td>(45.6)</td>
<td>(35.3)</td>
<td>(5.9)</td>
<td>(8.8)</td>
<td>(4.4)</td>
<td>1.9118</td>
<td>.565</td>
</tr>
<tr>
<td>Favor center for commercialization of faculty research</td>
<td>1</td>
<td>68</td>
<td>(20.6)</td>
<td>(39.7)</td>
<td>(17.6)</td>
<td>(14.7)</td>
<td>(7.4)</td>
<td>2.4853</td>
<td>.069</td>
</tr>
<tr>
<td>Alliances will alter standards for promotion and tenure</td>
<td>1</td>
<td>68</td>
<td>(5.9)</td>
<td>(20.6)</td>
<td>(16.2)</td>
<td>(45.6)</td>
<td>(11.8)</td>
<td>3.3676</td>
<td>.026</td>
</tr>
<tr>
<td>I will participate in alliances for extra income</td>
<td>1</td>
<td>68</td>
<td>(26.5)</td>
<td>(54.4)</td>
<td>(7.4)</td>
<td>(11.8)</td>
<td>(3.3)</td>
<td>2.2353</td>
<td>.004</td>
</tr>
</tbody>
</table>

*Denotes significance at the .05 level
**Denotes significance at the .01 level

Group 1: Applied Sciences Faculty
Group 2: Liberal Arts Faculty and Other Faculty

Key: SA-Strongly Agree, A-Agree, NO-No Opinion, D-Disagree, SD-Strongly Disagree
At the .01 level, the two groups differed considerably in their responses concerning creation of an institutional center for selective commercialization of faculty research as an alternative to research connections with industry. Among the applied sciences faculty, 60.3% favored the alternative center, compared to just 41.7% of the liberal arts faculty who favored the center.

No significant differences were evident in the reports of the two groups with respect to the criteria for salary adjustments and promotion for faculty members. Both reported that teaching and basic research should be the basic criteria. Most of the faculty members in the two groups also disagreed with the speculation that consulting faculty are often overly rewarded or compensated and the impression that consulting minimizes pressure from faculty members for salary increases. An overwhelming majority of the two groups, 80.9% of the applied science faculty and 86.6% of the liberal arts faculty, reported that administrators favor research over teaching and service when making promotion and tenure decisions.

Future of Business Partnerships in Higher Education

The sixth research question addressed the future of research agreements between universities and industry. In order to answer this question, faculty responses were solicited on six predictor variables. One of the most
highlighted advantages of university-industry alliances is that faculty scientists are exposed to the real world of research. On the contrary, critics counter that such exposure could eventually lead to a shortage of talented faculty members because businesses lure consulting faculty with more attractive salaries and fringe benefits. Faculty responses were sought concerning the likelihood that alliances would reduce the supply of talented faculty in the future, and whether universities would continue to depend upon corporations to replace revenue lost due to federal and state budget cutbacks.

Considering the fact that the success of business partnerships in higher education seems to depend largely upon support from faculty members, faculty were asked to respond to the assumption that a monitoring council (comprised of faculty members from all disciplines) is needed to facilitate consulting activities and to reduce the fear of potential or real implications of university-industry alliances for the universities. Faculty were also queried on how they viewed their future involvement in university-industry alliances.

In addition, faculty were asked to respond to the proposal that support for university-industry alliances would improve if all faculty were supported with revenue from royalties gained in alliances. Finally, subjects were asked to indicate their level of agreement or disagreement
with the idea that consulting faculty should explore sources other than corporations to support their research in the future. The frequency and percentage distributions of data collected to answer research question six are provided in Table 8.

Table 8

Future Relationships Between Higher Education and Businesses in the Perceptions of Applied Sciences Faculty and Liberal Arts and Other Faculty With Respect to Supply of Faculty, University Dependence on Industrial Funds, Creation of Monitoring Council, Involvement in Alliances, Support for Nonpaid Consultants, and Sources for Research Funds

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Group</th>
<th>N</th>
<th>1-SA</th>
<th>2-A</th>
<th>3-NO</th>
<th>4-D</th>
<th>5-SD</th>
<th>Mean Scores</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliances will</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reduce supply of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>talented faculty</td>
<td>Group 1:</td>
<td>68</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>39</td>
<td>14</td>
<td>3.8824</td>
<td>.444</td>
</tr>
<tr>
<td></td>
<td>Group 2:</td>
<td>59</td>
<td>1</td>
<td>4</td>
<td>12</td>
<td>33</td>
<td>9</td>
<td>3.7627</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.9)</td>
<td>(4.4)</td>
<td>(14.7)</td>
<td>(57.4)</td>
<td>(20.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University will</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>continue to need</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>industry funds</td>
<td></td>
<td></td>
<td>24</td>
<td>39</td>
<td>1</td>
<td>4</td>
<td></td>
<td>1.7794</td>
<td>.409</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(35.3)</td>
<td>(57.4)</td>
<td>(1.5)</td>
<td>(5.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creation of moni-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>toring council</td>
<td></td>
<td></td>
<td>5</td>
<td>19</td>
<td>15</td>
<td>21</td>
<td>8</td>
<td>3.1176</td>
<td>.000</td>
</tr>
<tr>
<td>will reduce fear</td>
<td></td>
<td></td>
<td>(7.4)</td>
<td>(27.9)</td>
<td>(22.1)</td>
<td>(30.9)</td>
<td>(11.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of implications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of alliances</td>
<td></td>
<td></td>
<td>(13.3)</td>
<td>(56.7)</td>
<td>(6.7)</td>
<td>(5.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I anticipate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>involvement in</td>
<td></td>
<td></td>
<td>17</td>
<td>29</td>
<td>14</td>
<td>7</td>
<td>1</td>
<td>2.2059</td>
<td>.003</td>
</tr>
<tr>
<td>alliances</td>
<td></td>
<td></td>
<td>(25.0)</td>
<td>(42.6)</td>
<td>(20.6)</td>
<td>(10.6)</td>
<td>(1.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>alliances will</td>
<td></td>
<td></td>
<td>6</td>
<td>21</td>
<td>18</td>
<td>11</td>
<td>4</td>
<td>2.7667</td>
<td>*</td>
</tr>
<tr>
<td>improve if all</td>
<td></td>
<td></td>
<td>(10.0)</td>
<td>(35.0)</td>
<td>(30.0)</td>
<td>(18.5)</td>
<td>(6.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>faculty receive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>benefits</td>
<td></td>
<td></td>
<td>(15.0)</td>
<td>(35.0)</td>
<td>(30.0)</td>
<td>(18.5)</td>
<td>(6.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty to seek</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>research funds</td>
<td></td>
<td></td>
<td>12</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td>1</td>
<td>2.5882</td>
<td>.597</td>
</tr>
<tr>
<td>from elsewhere</td>
<td>Group 1:</td>
<td>68</td>
<td>12</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td></td>
<td>2.5882</td>
<td>.597</td>
</tr>
<tr>
<td></td>
<td>Group 2:</td>
<td>60</td>
<td>12</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td></td>
<td>2.5882</td>
<td>.597</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(17.6)</td>
<td>(29.4)</td>
<td>(29.4)</td>
<td>(23.5)</td>
<td>(16.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Denotes significance at the .05 level

Group 1: Applied Sciences Faculty
Group 2: Liberal Arts Faculty and Other Faculty
Key: SA-Strongly Agree, A-Agree, NO-No Opinion, D-Disagree, SD-Strongly Disagree
As indicated by the data in Table 8, the two groups of faculty were significantly different in their responses at the .05 level on two of the six predictive variables that constituted the sixth research question, which addressed future relationships between higher education and businesses. Total percentages of strongly agree/agree and strongly disagree/disagree are reported for each group.

A significant difference was evident between the responses of the two groups regarding the recommendation that a monitoring council or committee be created by each university in order to allay the fear of real or potential implications of alliances for higher education and to enhance communication between the two groups. A majority (70.0%) of the liberal arts faculty favored the recommendation, while 42.7% of the applied sciences faculty opposed it. A significant difference also was evident between the two groups regarding their optimism for future involvement in alliances. Similar to previous findings in this study, the applied sciences faculty expressed higher optimism than did the liberal arts faculty. For example, while 67.6% of the applied sciences faculty anticipated involvement in alliances, only 45.0% of the liberal arts faculty anticipated involvement.

No significant statistical differences were evident between the responses of the two groups concerning the possibility that alliances could reduce the supply of
talented faculty, that the university would continue to
depend on industry funds for research and development, that
support for alliances would improve if all faculty received
benefits, and that a need existed to diversify sources of
research funds in the future. Contrary to the fear of some
scholars that alliances would lure faculty members from
academe with attractive salaries and benefits and thus
reduce the supply of talented faculty members, 78.0% of the
applied sciences faculty and 71.2% of the liberal arts
faculty reported that alliances would not reduce the supply
of talented faculty. Similarly, 92.7% of the applied
sciences faculty and 88.4% of the liberal arts faculty
reported that the university would continue to depend on
industry funds to supplement federal and state support for
university research and development.

Summary of Major Findings

The following is the summary of major findings of this
study:

1. Applied sciences faculty reported greater
opportunity and optimism for involvement in university-
industry alliances than did liberal arts faculty.
Approximately two-thirds of the applied sciences faculty,
compared to only one-third of the liberal arts faculty
reported having some experience in alliances. Similarly,
67.0% of the applied sciences faculty, compared to just
45.0% of the liberal arts faculty reported anticipation in alliances.

2. Liberal arts faculty appeared less likely to agree than applied sciences faculty that alliances do not pose a risk to the autonomy and lines of administrative control of a university.

3. The two groups differed considerably concerning the choice of research projects among consulting faculty. A majority (55.0%) of the liberal arts faculty reported that consulting faculty were more interested in research with commercial values than basic research, while 42.6% of the applied sciences faculty disagreed.

4. Applied sciences faculty appeared more likely to agree than liberal arts faculty that alliances do not pose a risk to the tradition of peer review of research findings.

5. A significant statistical difference was evident between the responses of the two groups with respect to the amount of time that consulting faculty devote to students, compared to the amount of time they devote to proprietary research. In applied sciences, 44.1% of the faculty reported that consulting faculty devote more time to students than proprietary research, but 33.4% of the liberal arts faculty disagreed.

6. The two groups differed considerably in their responses to the general notion that due to certain contractual agreements, consulting faculty are basically
secretive about research projects. Approximately 44.0% of the applied sciences faculty disagreed with the notion, but 37.3% of the liberal arts faculty agreed.

7. A majority (63.0%) of the liberal arts faculty, and 44.1% of the applied sciences faculty reported that discoveries from proprietary research should be taught to students.

8. The two groups also differed considerably in their responses concerning the possibility that alliances could alter the conventional standards of promotion and tenure. A majority (57.4%) of the applied sciences faculty disagreed with the possibility, but almost equal numbers of faculty members agreed and disagreed among the liberal arts faculty.

9. In order to allay fear of potential or real implications of alliances for higher education, 70.0% of the liberal arts faculty favored the creation of a monitoring council by each research university, but 42.7% of the applied sciences faculty disagreed.

10. Approximately 82% of respondents from each group reported that alliances enhance the image of their universities.

11. More than 70% of the respondents from each group believed that corporate research funds attract and retain quality faculty.

12. The majority of the two groups, 55.9% of the applied sciences faculty and 60.0% of the liberal arts
faculty, reported that alliances improve the quality of instruction.

13. More than 60% of the respondents from each group believed that the number of consulting faculty holding equity or important posts in private companies is insignificant to raise concern to administrators.

14. At least 53% of the respondents from each group believed that consulting faculty should be required to declare any personal interest in private companies, especially if they receive research grants from such private companies.

15. The majority of both groups, 78.0% of the applied sciences faculty and 71.2% of the liberal arts faculty, reported that alliances would not reduce the supply of talented faculty in the future.

16. An overwhelming majority of each group, 92.7% of the applied sciences faculty and 88.4% of the liberal arts faculty, believed that research universities will continue to rely on corporate funds to supplement federal and state support for research and development.

A summary, discussion of major findings, conclusions, and recommendations for future research are presented in Chapter 5.
CHAPTER 5

SUMMARY OF MAJOR FINDINGS, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

The central purpose of this study was to compare the attitudes of faculty in applied sciences and faculty in liberal arts toward the effects of university-industry alliances on the governance and operation of a university. Secondary themes of the study included an attempt to (a) appraise the debate on alliances and the effects of alliances on academic values and (b) contribute to the literature concerning alliances and their potential for improving higher education. The purpose of the study followed the assumptions of Nora and Olivas (1988) that faculty in applied research fields (engineering, agriculture, medicine, pharmacy, etc.) would be most supportive of industrially sponsored research and that faculty in social sciences and humanities would be less enthusiastic and socially critical of it because of their limited opportunities for participation, their "higher minded view" of the missions of the university, the important role of liberal education in the university, and how they perceive their roles in the training of students.
Of the 250 faculty members surveyed for the study, 145 (58%) returned their surveys, but only 128 (51.2%) were considered usable. The group characterized as applied science faculty was represented by 68 (54.4%) of the 125 faculty members and were drawn from biological sciences, chemistry, computer sciences, engineering (electrical and mechanical), biomedical sciences, and physics/material characterization. The second group, which was characterized as liberal arts faculty for the purpose of this study, was represented by 60 (48%) of the 125 faculty members and were drawn from business administration, economics, education, history, political science, psychology, and sociology. All faculty members were randomly selected from the faculty at the University of Texas at Dallas (UTD) and the University of North Texas (UNT) in Denton. The two rapidly-growing research universities are located in the Dallas-Fort Worth metroplex—a center for scores of conglomerated finance and service businesses and small manufacturers, distributors, and high-tech corporations utilizing the services of an international airport and higher education institutions in the metroplex. Frequencies, percentages, and means were used to describe the responses.

Summary of Major Findings

The findings resulting from the statistical analysis of data are summarized as follows:
1. Applied science faculty report greater opportunity and optimism for involvement in university-industry alliances than liberal arts faculty. Approximately two-thirds of applied science faculty, compared to only one-third of liberal arts faculty, report having some experience in alliances. Similarly, 67.0% of the applied science faculty, compared to just 45.0% of the liberal arts faculty, report anticipation in alliances.

2. Liberal arts faculty appear less likely to agree than applied science faculty that alliances do not pose a risk to the autonomy and lines of administrative control of the university.

3. The two groups differ considerably from each other with respect to choice of research projects among consulting faculty. A majority (55.0%) of the liberal arts faculty report that consulting faculty are more interested in research with commercial values than basic research, while 42.6% of the applied science faculty disagree.

4. Applied science faculty appear more likely to agree than liberal arts faculty that alliances do not pose a risk to the tradition of peer review of research findings.

5. A significant statistical difference exists between the responses of the two groups with respect to the amount of time that consulting faculty devote to students, compared to the amount of time they devote to proprietary research. In applied science, 44.1% report that consulting faculty
devote more time to students than proprietary research, but 33.4% of the liberal arts faculty disagree.

6. The two groups differ considerably in their responses to the general notion that due to certain contractual agreements, consulting faculty are basically secretive about research projects. Approximately 44.0% of the applied science faculty disagree with the notion, but 37.3% of the liberal arts faculty agree.

7. A majority (63.0%) of the liberal arts faculty and 44.1% of the applied science faculty report that discoveries from proprietary research should be taught to students.

8. The two groups also differ considerably in their responses concerning the possibility that alliances could alter the conventional standards of promotion and tenure. A majority (57.4%) of the applied science faculty disagree with the possibility, but almost an equal number agree or disagree among the liberal arts faculty.

9. In order to allay fear of potential or real implications of alliances for higher education, 70.0% of the liberal arts faculty favor creation of a monitoring council by each research university, but 42.7% of the applied science faculty report an objection.

10. Approximately 82% of respondents from each group report that alliances enhance the image of their universities.
11. Over 70% of respondents from each group believe that corporate research funds attract and retain quality faculty.

12. The majority of the two groups, 55.9% of the applied science faculty and 60% of the liberal arts faculty, report that alliances improve the quality of instruction.

13. Over 60% of respondents from each group believe that the number of consulting faculty holding equity or important posts in private companies is insignificant to raise concern to administrators.

14. At least 53% of respondents from each group believe that consulting faculty should be required to declare any personal interest in private companies, especially if they receive research grants from such private companies.

15. The majority of both groups, 78.0% of the applied science faculty and 71.2% of the liberal arts faculty, report that alliances could not reduce the supply of talented faculty in the future.

16. An overwhelming majority of each group, 92.7% of the applied science faculty and 88.4% of the liberal arts faculty, believe that research universities will continue to rely on corporate funds to supplement federal and state support for research and development.
Discussion of Major Findings

Much of the controversy concerning the effects of university-industry alliances on academe emanates from the hearing before the Senate Subcommittee on Investigations and Oversight in 1982 regarding certain research agreements between businesses and university scientists. Such controversial research agreements include the following: the Massachusetts General Hospital-Hoechst $70 million biomedical research agreements in 1981; the University of California at Davis-Allied Chemical Company research agreements in 1982; the Washington University-Anheuser Busch $600,000 micromixing research agreements in 1983; the Washington University-MallincKrodt $3.9 million hybridoma research agreements in 1982; the Washington-Monsanto $23.5 million research agreements in proteins and peptides in 1982; and in California, the extension of the regulations of the Fair Political Practices Commission to all land-grant colleges and universities in 1982 after a professor was convicted of holding shares in a private company where he received research grants. In the words of Congressman Albert Gore, certain research agreements, especially with reference to the Washington University-Monsanto agreements, "allow the company to place guidelines on what university researchers may speak about in an academic forum" (Blumehthal, Gluck, Louis, Soto, & Wise, 1986; Omenn, 1982; Reams, 1984; Varrin & Kukich, 1985). Some of the major
controversies in these research agreements relate to covert research, ownership of intellectual property, autonomy of universities, intellectual freedom of consulting faculties, and tendency for consulting faculty to be averse to commercialization of research.

The attitudes of the two groups of faculty members toward the effects of university-industry alliances were compared on eight selected aspects of the operation and administration of the university. Based on the statistical analysis of their responses, faculty members in liberal arts seemed less likely than faculty members in applied science fields to agree that alliances do not pose a risk to the independence or autonomy of a university, to lines of administrative control of a university, and, to a certain extent, to the missions of a university and the commitment of consulting faculty to activities crucial to the health of a university. However, both groups agreed that alliances enhance the images of their universities and contribute to the fiscal stability of their universities. The differences between the two groups could possibly be explained by the assumption of Nora and Olivas (1988) that faculty members in liberal arts have a higher minded view of the missions and agendas of the university than do faculty in applied science fields.

The comparison of the attitudes of the two groups toward the effects of alliances on the quality of the
scholarly works of consulting faculty and the quality of instruction that students receive shows that the two groups differed significantly with respect to the choice of research problems among consulting faculty and peer review of research findings. A majority of the liberal arts faculty believed that consulting faculty are more interested in commercial research than basic research. In fact, most of those faculty also believed that alliances encourage classified research on campuses. Consequently, liberal arts faculty reported less agreement than did applied science faculty with the idea that alliances do not threaten the academic tradition of peer review. Nevertheless, both groups agreed that alliances attract and retain quality faculty members and contribute to the quality of instruction provided to students.

The two groups were also compared on the controversy concerning the extent of ethical abuse of alliances among consulting faculty. The analysis of their responses indicates that faculty in liberal arts were considerably different from faculty in applied science fields on two components. For example, 70% of the liberal arts faculty reported that consulting competes with university activities. Approximately half of those faculty also reported that consulting faculty devote more time to consulting or proprietary research than to students. In applied science fields, 44.1% of the faculty agreed that
consulting competes with university responsibilities. It is probable that the 44.1% who disagreed also reported that consulting faculty spend more time with proprietary research than with students. Following the extension of the regulations of the Fair Political Practices Act to all land-grant colleges and universities in California and the conviction of Scheffer C. G. Tseng of Harvard University of holding 530,000 shares in a company established to promote the drug he was experimenting at a Harvard-affiliated eye clinic in 1989 (McDowell, 1992, pp. 1, 27), there has been a public belief that more consulting faculty are involved. The findings of this study indicate the contrary because both groups reported that the number of consulting faculty possibly holding shares in private companies is insignificant to raise concern to administrators. Also, at least 53% of the respondents in both groups reported that consulting faculty should be required to declare any personal interest and its magnitude in private companies.

Significant differences were found between the responses of the two groups with regard to academic freedom of consulting faculty under contractual agreements. Notably, the two groups differed concerning the notion that consulting faculty have a tendency to be secretive about research in order to protect the profit advantage of the sponsoring industry and whether or not consulting faculty should teach findings of proprietary research to students.
For instance, 63.8% of the liberal arts faculty reported that findings from proprietary research should be taught to students, but applied science faculty believed the contrary. The assumption of Nora and Olivas (1988) that faculty in humanities and social sciences regard liberal education as the central function of the university and their perception of their roles in the training of students may explain the difference between the two groups.

Regarding the effects of alliances on faculty reward structures, the two groups were significantly different in their responses to the view held by some scholars that alliances have the potential to alter the conventional standards of promotion and salary increase to the advantage of faculty in alliances. A majority (57.4%) of the applied science faculty opposed the view, while almost equal numbers of faculty members agreed and disagreed among the liberal arts faculty.

The two groups agreed that future partnerships are essential to augment federal and state support for academic research and development. Both groups disagreed with the fear of some scholars that alliances would reduce the supply of talented faculty by luring them away with more attractive salaries and benefits. However, the two groups differed significantly concerning the suggestion that each university should establish a monitoring council to oversee consulting activities and to allay fear of real or imagined
implications of alliances which probably results from communication gaps between consultants and nonconsultants.

Conclusions

Based on the findings of this study, the following conclusions appear to be warranted:

1. Faculty members in applied sciences have more opportunity in alliances than do faculty in liberal arts.

2. Faculty in applied sciences are more supportive and defensive of industry than are faculty in liberal arts.

3. Faculty in liberal arts appear to be more protective of the autonomy and missions of the university than are faculty in applied sciences.

4. Faculty in liberal arts are more concerned about academic values such as freedom to research, teach, and publish than are faculty in applied sciences.

5. Both groups of faculty unanimously acknowledge the financial advantages, prestige, and instructional improvements that alliances have brought to research colleges and universities.

6. Faculty in applied sciences are more optimistic about future opportunities in alliances than are faculty in liberal arts.

7. A need exists for openness and communication between all faculty members and for a monitoring council or committee to be comprised of faculty from across all
disciplines to serve that purpose. At least two-thirds (70%) of the faculty in liberal arts favor such a council.

Recommendations

The following recommendations for future research are based on the findings and conclusions of this study.

1. Research to address the effects of university-industry alliances on the performance of consulting faculty members and university activities in the perceptions of academic administrators (deans, chairs, directors of programs, and the like) should be conducted.

2. Research to further investigate correlations between faculty opinions and academic affiliations should also be conducted. This topic was found to be complex and beyond the scope of this research.
APPENDIX A

SURVEY OF FACULTY ATTITUDES TOWARD THE EFFECTS OF UNIVERSITY-INDUSTRY ALLIANCES ON THE GOVERNANCE AND OPERATIONS OF HIGHER EDUCATION INSTITUTIONS
PART I

Instructions: Please, carefully read the following statements and respond by checking ( ) the appropriate space.

1. Indicate your academic discipline
   _____ Biology          _____ Business, School of
   _____ Chemistry        _____ Economics
   _____ Computer Science _____ Education, College
   _____ Engineering      _____ History
   _____ Biomedical Sciences _____ Political Science
   _____ Physics/Material Science _____ Psychology
   _____ Sociology

   I would classify myself as
   _____ a) Liberal Arts and Sciences Faculty
   _____ b) Applied Arts and Sciences Faculty

2. Indicate your rank
   _____ Professor          _____ Instructor
   _____ Associate Professor _____ Others
   _____ Assistant Professor (Please explain)

3. Highest degree earned
   _____ Bachelor's          _____ Doctorate
   _____ Master's            _____ Others
   (Please explain)

4. Have you had any experience in university-industry alliance?
   _____ Yes   _____ No

   Please indicate type(s) of alliance(s) ________________________________

5. Are (were) you a principal investigator (PI)
   _____ Yes   _____ No
PART II

Instructions: Please respond to each of the following questions by checking ( ) the space which most represents your opinion. Your responses will be treated confidentially and with anonymity.

1. Your attitude toward the effects of university-industry alliances on the operational and administrative functions of the university

   1. Business partnerships in higher education pose a risk to missions and agendas of the university
      1) ___ Strongly Agree 4) ___ Disagree
      2) ___ Agree 5) ___ Strongly Disagree
      3) ___ No Opinion

   2. The autonomy of the university is secure under university-industry alliances
      1) ___ Strongly Agree 4) ___ Disagree
      2) ___ Agree 5) ___ Strongly Disagree
      3) ___ No Opinion

   3. Consulting disrupts the traditional lines of administrative controls of the university
      1) ___ Strongly Agree 4) ___ Disagree
      2) ___ Agree 5) ___ Strongly Disagree
      3) ___ No Opinion

   4. Consulting does not harm the commitment of consulting faculty to administrative activities crucial to the health of the university
      1) ___ Strongly Agree 4) ___ Disagree
      2) ___ Agree 5) ___ Strongly Disagree
      3) ___ No Opinion

   5. My institution's consulting policies satisfactorily prevent consulting faculty from compromising their academic values with business
      1) ___ Strongly Agree 4) ___ Disagree
      2) ___ Agree 5) ___ Strongly Disagree
      3) ___ No Opinion

   6. Business partnerships with my university enhance its image
      1) ___ Strongly Agree 4) ___ Disagree
      2) ___ Agree 5) ___ Strongly Disagree
      3) ___ No Opinion
7. Business partnerships help stabilize the fiscal conditions of my university
   1) ___ Strongly Agree  4) ___ Disagree
   2) ___ Agree  5) ___ Strongly Disagree
   3) ___ No Opinion

8. Administrators are often passive in handling allegations of abuses by consulting faculty
   1) ___ Strongly Agree  4) ___ Disagree
   2) ___ Agree  5) ___ Strongly Disagree
   3) ___ No Opinion

II. Your attitude toward the effects of university-industry alliances on scholarship and quality of instruction

9. Proprietary research inhibits collegial discussion of research projects and consequently strains collegial relationships
   1) ___ Strongly Agree  4) ___ Disagree
   2) ___ Agree  5) ___ Strongly Disagree
   3) ___ No Opinion

10. Corporate funds attract and retain quality faculty members to the university
    1) ___ Strongly Agree  4) ___ Disagree
    2) ___ Agree  5) ___ Strongly Disagree
    3) ___ No Opinion

11. Consulting faculty appear to be more interested in research projects with commercial value than basic research
    1) ___ Strongly Agree  4) ___ Disagree
    2) ___ Agree  5) ___ Strongly Disagree
    3) ___ No Opinion

12. Alliances encourage "classified research" which contradicts the academic principle of free and open exchange of information
    1) ___ Strongly Agree  4) ___ Disagree
    2) ___ Agree  5) ___ Strongly Disagree
    3) ___ No Opinion

13. Consulting improves the quality of instruction
    1) ___ Strongly Agree  4) ___ Disagree
    2) ___ Agree  5) ___ Strongly Disagree
    3) ___ No Opinion

14. Alliances do no threaten peer review of faculty research
    1) ___ Strongly Agree  4) ___ Disagree
    2) ___ Agree  5) ___ Strongly Disagree
    3) ___ No Opinion
III. Your estimate of the magnitude of ethical and legal abuses of alliances by consulting faculty members

15. Conflict of interest in research is widespread in my university and/or elsewhere I know of
   1) ____ Strongly Agree  4) ____ Disagree
   2) ____ Agree  5) ____ Strongly Disagree
   3) ____ No Opinion

16. The number of faculty holding equity and/or important positions in private companies is not significant enough to raise concern to administrators
   1) ____ Strongly Agree  4) ____ Disagree
   2) ____ Agree  5) ____ Strongly Disagree
   3) ____ No Opinion

17. Consulting faculty should not be required to declare his/her interest in a private company, if any, and the magnitude of the interest
   1) ____ Strongly Agree  4) ____ Disagree
   2) ____ Agree  5) ____ Strongly Disagree
   3) ____ No Opinion

18. Consulting is time consuming and competitive with the university activities
   1) ____ Strongly Agree  4) ____ Disagree
   2) ____ Agree  5) ____ Strongly Disagree
   3) ____ No Opinion

19. Consulting faculty spend more time with their students than they spend with corporate-funded research
   1) ____ Strongly Agree  4) ____ Disagree
   2) ____ Agree  5) ____ Strongly Disagree
   3) ____ No Opinion

20. State government should be involved in policy design for research agreements in order to protect taxpayer's investment in basic research
   1) ____ Strongly Agree  4) ____ Disagree
   2) ____ Agree  5) ____ Strongly Disagree
   3) ____ No Opinion

IV. Academic freedom vs. contractual agreements

21. Corporations attach more strings to research funds than do federal and state governments
   1) ____ Strongly Agree  4) ____ Disagree
   2) ____ Agree  5) ____ Strongly Disagree
   3) ____ No Opinion
22. In order for consulting faculty to publish their research findings, corporations should hold the right of ownership of research no longer than three (3) months

1) ___ Strongly Agree 4) ___ Disagree
2) ___ Agree 5) ___ Strongly Disagree
3) ___ No Opinion

23. Basically, consulting faculty have the tendency to be secretive about their research projects

1) ___ Strongly Agree 4) ___ Disagree
2) ___ Agree 5) ___ Strongly Disagree
3) ___ No Opinion

24. Consulting faculty should comply with corporate rule by not making reference to their research projects in their publications

1) ___ Strongly Agree 4) ___ Disagree
2) ___ Agree 5) ___ Strongly Disagree
3) ___ No Opinion

25. Consulting faculty publish more than nonconsulting faculty members

1) ___ Strongly Agree 4) ___ Disagree
2) ___ Agree 5) ___ Strongly Disagree
3) ___ No Opinion

26. All rights to patents resulting from consulting should belong to the university

1) ___ Strongly Agree 4) ___ Disagree
2) ___ Agree 5) ___ Strongly Disagree
3) ___ No Opinion

27. Consulting faculty should teach his/her research findings to students regardless of how businesses feel

1) ___ Strongly Agree 4) ___ Disagree
2) ___ Agree 5) ___ Strongly Disagree
3) ___ No Opinion

V. The effects of university-industry alliances on faculty reward structures

28. Teaching and basic research should be the primary basis for promotion and salary increase

1) ___ Strongly Agree 4) ___ Disagree
2) ___ Agree 5) ___ Strongly Disagree
3) ___ No Opinion
29. Consulting faculty members are somehow overly compensated or promoted
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion

30. Administrators should encourage consulting because extra income reduces pressure for salary increase by faculty members
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion

31. Strictly speaking, administrators favor research over teaching and service in promotion decisions
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion

32. It is appropriate for my university to establish a center for a selective commercialization of faculty research
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion

33. Alliances pose the risk of altering standards of promotion and tenure
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion

34. I welcome the opportunity to participate in alliances for additional income
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion

V. The future of business partnerships in higher education

35. Alliances will reduce the supply of talented faculty members in the future
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion

36. Universities will continue to need corporate funds to replace federal and state financial cutbacks
   1) ___ Strongly Agree    4) ___ Disagree
   2) ___ Agree            5) ___ Strongly Disagree
   3) ___ No Opinion
37. Fear of the implications of alliances could be reduced in the future if each university established a monitoring council
1) _____ Strongly Agree 4) _____ Disagree
2) _____ Agree 5) _____ Strongly Disagree
3) _____ No Opinion

38. I anticipate involvement in university-industry alliances
1) _____ Strongly Agree 4) _____ Disagree
2) _____ Agree 5) _____ Strongly Disagree
3) _____ No Opinion

39. If unpaid consultants are supported from royalties shared by the university and paid consultants, support for alliances will improve dramatically among faculty members
1) _____ Strongly Agree 4) _____ Disagree
2) _____ Agree 5) _____ Strongly Disagree
3) _____ No Opinion

40. In the future, consulting faculty members should seek funds from sources other than businesses
1) _____ Strongly Agree 4) _____ Disagree
2) _____ Agree 5) _____ Strongly Disagree
3) _____ No Opinion
APPENDIX B

1. Is the question useful? Does it get at the desired information?

2. Is it probable that respondents will have the information necessary to answer the question?

3. Is the question free form bias, or is it loaded such that the respondent might react with prejudice he or she would not otherwise experience?

4. Is the question so personal or private that the respondent will be reluctant to give an honest answer?

5. Is the wording of the question clear? Does it contain difficult words that the average respondent may not understand?

6. Is the order of the question both logical and helpful in keeping the respondent answering; that is, do the questions flow from easy to difficult?

Date: September 1, 1991.

Dear Sir/Madam,

I am a doctoral student in higher education at the University of North Texas. The enclosed questionnaire has been constructed to test the attitudes of faculty members in applied sciences vs. faculty members in liberal arts toward the effects of university-industry alliances on the governance and operation of higher education institutions. The study will be administered at two research universities in Texas.

Since this is a pilot study of the instrument, please, note that your early response and generous comments (if any) will be a major contribution to the content validity of the instrument. Please, return questionnaire by September 15, 1991. Your confidentiality is assured.

Thanks.

Dr. Dwane Kingery                Femi Abegunde
Professor of Higher/Adult        Doctoral Student
Education                        University of North Texas
University of North Texas        P.O. Box 9273, Denton, TX
Denton, TX    76203              (817) XXX-XXXX (HM)
(817) XXX-XXXX                    (817) XXX-XXXX (WK)
1. Your Comments:

2. ________ Please, check (v) if you would like to have a copy of the abstract of the dissertation.
APPENDIX D
POSTCARD
Dr.
As an experienced faculty member, you have been selected to participate in a survey study on Faculty Attitudes Toward University-Industry Alliances. Your questionnaire will be mailed to you approximately one week after you have received this card. I humbly request your cooperation by responding to the questions accurately and promptly.
Thanks.
Femi Abegunde
Doctoral Student (UNT)
APPENDIX E

COVER LETTER--STUDY
Name,

Approximately a week ago, you received a postcard concerning the study: Faculty Attitudes Toward the Effects of University-Industry Alliances on the Governance and Operation of Institutions of Higher Education. Since the 1960s, attitudinal studies have been done to gauge faculty attitudes toward economic, political, and social issues. Within the last few decades, many scholars have also investigated the legal, ethical, and tax issues concerning university-industry alliances. However, relatively few studies have been devoted exclusively to exploring faculty perceptions of the effects that alliances have on the governance and operations of higher education institutions.

As a doctoral candidate in Higher Education Administration at the University of North Texas, I am conducting a study to compare the attitudes of faculty members in applied sciences versus faculty members in liberal arts. It takes a minimum of 10 minutes and a maximum of 15 minutes to complete this survey. I would be most thankful if you will spare these few minutes of your busy schedule to complete the survey and return it by November 20, 1991. I should like to assure you that your response will be treated with complete confidentiality and anonymity. A stamped self-addressed envelope has been provided for your convenience.

If you have any questions about any items on the survey, please contact me at the address or telephone provided above. I do appreciate your participation. I am looking forward to your response.

Sincerely,

Olufemi Abegunde

__________ Please, check (x) if you would like to have a copy of the results of this survey.
APPENDIX F

FOLLOW-UP LETTER
to remind you of my survey. Thank you for your cooperation in completing and returning it to me.

Femi Abegunde
APPENDIX G

T - TEST
<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
<th>F 2-tail Value</th>
<th>Prob</th>
<th>t Degrees of 2-tail Freedom</th>
<th>Prob</th>
<th>t Degrees of 2-tail Freedom</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD1</td>
<td>GROUP 1 88</td>
<td>3.5441</td>
<td>1.284</td>
<td>.156</td>
<td>1.00</td>
<td>.995</td>
<td>1.73</td>
<td>126</td>
<td>.086</td>
<td>1.73</td>
</tr>
<tr>
<td></td>
<td>GROUP 2 60</td>
<td>2.1500</td>
<td>1.287</td>
<td>.180</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD2</td>
<td>GROUP 1 88</td>
<td>2.4118</td>
<td>1.225</td>
<td>.149</td>
<td>1.07</td>
<td>.803</td>
<td>-2.13</td>
<td>128</td>
<td>.035</td>
<td>-2.13</td>
</tr>
<tr>
<td></td>
<td>GROUP 2 60</td>
<td>2.8687</td>
<td>1.186</td>
<td>.153</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD3</td>
<td>GROUP 1 88</td>
<td>3.0878</td>
<td>1.064</td>
<td>.129</td>
<td>1.19</td>
<td>.468</td>
<td>2.33</td>
<td>125</td>
<td>.021</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td>GROUP 2 59</td>
<td>3.4088</td>
<td>1.181</td>
<td>.151</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD4</td>
<td>GROUP 1 88</td>
<td>2.2941</td>
<td>1.128</td>
<td>.137</td>
<td>1.08</td>
<td>.744</td>
<td>-1.00</td>
<td>124</td>
<td>.308</td>
<td>-1.00</td>
</tr>
<tr>
<td></td>
<td>GROUP 2 58</td>
<td>2.8376</td>
<td>1.136</td>
<td>.155</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD5</td>
<td>GROUP 1 88</td>
<td>2.8329</td>
<td>1.137</td>
<td>.137</td>
<td>1.54</td>
<td>.202</td>
<td>-1.50</td>
<td>128</td>
<td>.119</td>
<td>-1.50</td>
</tr>
<tr>
<td></td>
<td>GROUP 2 60</td>
<td>2.8332</td>
<td>1.128</td>
<td>.128</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD6</td>
<td>GROUP 1 88</td>
<td>2.0000</td>
<td>.977</td>
<td>.119</td>
<td>1.58</td>
<td>.076</td>
<td>.42</td>
<td>126</td>
<td>.673</td>
<td>.43</td>
</tr>
<tr>
<td></td>
<td>GROUP 2 60</td>
<td>1.9333</td>
<td>.778</td>
<td>.100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD7</td>
<td>GROUP 1 88</td>
<td>2.3529</td>
<td>1.064</td>
<td>.122</td>
<td>1.12</td>
<td>.687</td>
<td>.59</td>
<td>128</td>
<td>.554</td>
<td>.80</td>
</tr>
<tr>
<td>Variable</td>
<td>Number of Cases</td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Standard Error</td>
<td>F 2-tail Value</td>
<td>Prob</td>
<td>t Degrees of Freedom</td>
<td>Pooled Variance estimate</td>
<td>Separate Variance Estimate</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>----------------</td>
<td>------</td>
<td>-------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>AD8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>68</td>
<td>2.0676</td>
<td>0.01</td>
<td>0.12</td>
<td>1.77</td>
<td>0.027</td>
<td>5.6</td>
<td>125.57</td>
<td>57.122.58</td>
<td></td>
</tr>
<tr>
<td>GROUP 2</td>
<td>59</td>
<td>2.7797</td>
<td>0.74</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>68</td>
<td>3.2941</td>
<td>1.23</td>
<td>0.15</td>
<td>1.23</td>
<td>0.15</td>
<td>1.49</td>
<td>126.139</td>
<td>1.50 125.64</td>
<td></td>
</tr>
<tr>
<td>GROUP 2</td>
<td>80</td>
<td>2.0433</td>
<td>1.12</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>68</td>
<td>2.5000</td>
<td>1.04</td>
<td>0.12</td>
<td>1.64</td>
<td>0.053</td>
<td>1.40</td>
<td>126.184</td>
<td>1.42 124.26</td>
<td></td>
</tr>
<tr>
<td>GROUP 2</td>
<td>60</td>
<td>2.0167</td>
<td>0.81</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>68</td>
<td>3.0588</td>
<td>1.25</td>
<td>0.15</td>
<td>2.17</td>
<td>0.033</td>
<td>2.65</td>
<td>126.009</td>
<td>2.71 119.56</td>
<td></td>
</tr>
<tr>
<td>GROUP 2</td>
<td>80</td>
<td>2.5500</td>
<td>0.82</td>
<td>0.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>68</td>
<td>3.1471</td>
<td>1.17</td>
<td>0.14</td>
<td>1.74</td>
<td>0.257</td>
<td>1.69</td>
<td>126.084</td>
<td>1.71 125.96</td>
<td></td>
</tr>
<tr>
<td>GROUP 2</td>
<td>80</td>
<td>2.8187</td>
<td>1.01</td>
<td>0.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>68</td>
<td>2.0324</td>
<td>1.20</td>
<td>0.14</td>
<td>1.15</td>
<td>0.587</td>
<td>0.80</td>
<td>126.426</td>
<td>0.80 125.60</td>
<td></td>
</tr>
<tr>
<td>GROUP 2</td>
<td>60</td>
<td>2.4667</td>
<td>1.12</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>68</td>
<td>2.4558</td>
<td>1.07</td>
<td>0.13</td>
<td>1.36</td>
<td>0.226</td>
<td>-2.22</td>
<td>126.028</td>
<td>-2.24 125.99</td>
<td></td>
</tr>
<tr>
<td>GROUP 2</td>
<td>80</td>
<td>2.8500</td>
<td>0.87</td>
<td>0.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>GROUP 1</td>
<td>GROUP 2</td>
<td>GROUP 1</td>
<td>GROUP 2</td>
<td>GROUP 1</td>
<td>GROUP 2</td>
<td>GROUP 1</td>
<td>GROUP 2</td>
<td>GROUP 1</td>
<td>GROUP 2</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>ET1</td>
<td>68</td>
<td>88</td>
<td>.107</td>
<td>.105</td>
<td>1.18</td>
<td>.518</td>
<td>1.85</td>
<td>.101</td>
<td>1.85</td>
<td>.101</td>
</tr>
<tr>
<td>ET2</td>
<td>67</td>
<td>813</td>
<td>.098</td>
<td>.101</td>
<td>1.09</td>
<td>.750</td>
<td>-1.01</td>
<td>.315</td>
<td>-1.01</td>
<td>.315</td>
</tr>
<tr>
<td>ET3</td>
<td>68</td>
<td>1.788</td>
<td>.156</td>
<td>.152</td>
<td>1.27</td>
<td>.445</td>
<td>.00</td>
<td>.897</td>
<td>.00</td>
<td>.897</td>
</tr>
<tr>
<td>ET4</td>
<td>68</td>
<td>1.287</td>
<td>.156</td>
<td>.133</td>
<td>1.55</td>
<td>.087</td>
<td>2.51</td>
<td>.013</td>
<td>2.51</td>
<td>.013</td>
</tr>
<tr>
<td>ET5</td>
<td>68</td>
<td>1.043</td>
<td>.129</td>
<td>.112</td>
<td>1.50</td>
<td>.112</td>
<td>-2.58</td>
<td>.010</td>
<td>-2.58</td>
<td>.010</td>
</tr>
<tr>
<td>ET6</td>
<td>68</td>
<td>1.315</td>
<td>.150</td>
<td>.145</td>
<td>1.38</td>
<td>.211</td>
<td>.00</td>
<td>.988</td>
<td>.00</td>
<td>.988</td>
</tr>
<tr>
<td>FR1</td>
<td>68</td>
<td>1.259</td>
<td>.153</td>
<td>.134</td>
<td>1.47</td>
<td>.133</td>
<td>-1.87</td>
<td>.060</td>
<td>-1.87</td>
<td>.060</td>
</tr>
<tr>
<td>Variable</td>
<td>Number of Cases</td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Standard Error</td>
<td>F Value</td>
<td>1 Degrees of 2-tail Value</td>
<td>1 Degrees of 2-tail Freedom</td>
<td>Pooled Variance Estimate</td>
<td>Separate Variance Estimate</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>----------------</td>
<td>------</td>
<td>--------------------</td>
<td>----------------</td>
<td>---------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td>FR1</td>
<td>GROUP 1</td>
<td>68</td>
<td>3.7059</td>
<td>1.148</td>
<td>1.96</td>
<td>.011</td>
<td>2.10</td>
<td>124</td>
<td>.097</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>58</td>
<td>2.8278</td>
<td>.816</td>
<td>1.96</td>
<td>.009</td>
<td>2.10</td>
<td>120</td>
<td>.032</td>
<td></td>
</tr>
<tr>
<td>FR2</td>
<td>GROUP 1</td>
<td>68</td>
<td>3.2353</td>
<td>1.053</td>
<td>1.00</td>
<td>.068</td>
<td>2.60</td>
<td>125</td>
<td>.008</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>59</td>
<td>2.7707</td>
<td>.802</td>
<td>1.00</td>
<td>.072</td>
<td>2.72</td>
<td>123</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td>FR3</td>
<td>GROUP 1</td>
<td>68</td>
<td>2.9118</td>
<td>1.018</td>
<td>1.05</td>
<td>.847</td>
<td>-1.18</td>
<td>124</td>
<td>248</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>58</td>
<td>3.1207</td>
<td>.993</td>
<td>1.05</td>
<td>.816</td>
<td>-1.16</td>
<td>121</td>
<td>247</td>
<td></td>
</tr>
<tr>
<td>FR4</td>
<td>GROUP 1</td>
<td>68</td>
<td>2.9553</td>
<td>1.044</td>
<td>1.42</td>
<td>.176</td>
<td>-50</td>
<td>125</td>
<td>.905</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>59</td>
<td>3.0847</td>
<td>.877</td>
<td>1.42</td>
<td>.176</td>
<td>-50</td>
<td>124</td>
<td>561</td>
<td></td>
</tr>
<tr>
<td>FR5</td>
<td>GROUP 1</td>
<td>68</td>
<td>3.7784</td>
<td>.975</td>
<td>1.20</td>
<td>.327</td>
<td>1.74</td>
<td>125</td>
<td>.084</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>59</td>
<td>3.4586</td>
<td>1.104</td>
<td>1.20</td>
<td>.327</td>
<td>1.74</td>
<td>124</td>
<td>.086</td>
<td></td>
</tr>
<tr>
<td>FR6</td>
<td>GROUP 1</td>
<td>68</td>
<td>3.1176</td>
<td>1.216</td>
<td>1.22</td>
<td>.421</td>
<td>2.41</td>
<td>124</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>59</td>
<td>2.5345</td>
<td>1.066</td>
<td>1.22</td>
<td>.421</td>
<td>2.41</td>
<td>123</td>
<td>.005</td>
<td></td>
</tr>
<tr>
<td>FR7</td>
<td>GROUP 1</td>
<td>68</td>
<td>4.9559</td>
<td>1.133</td>
<td>1.22</td>
<td>.427</td>
<td>-66</td>
<td>128</td>
<td>.488</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>60</td>
<td>2.1000</td>
<td>1.259</td>
<td>1.22</td>
<td>.427</td>
<td>-66</td>
<td>119</td>
<td>.500</td>
<td></td>
</tr>
</tbody>
</table>

120
<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
<th>F Value</th>
<th>2-tail Prob</th>
<th>1 Degrees of Freedom</th>
<th>1 Degrees of Freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE2</td>
<td>Group 1</td>
<td>68</td>
<td>3.5000</td>
<td>985</td>
<td>.119</td>
<td>1.70</td>
<td>.201</td>
<td>81</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>60</td>
<td>3.9687</td>
<td>863</td>
<td>.111</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE3</td>
<td>Group 1</td>
<td>68</td>
<td>3.9382</td>
<td>1.114</td>
<td>.135</td>
<td>1.20</td>
<td>473</td>
<td>-77</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>60</td>
<td>3.4933</td>
<td>1.017</td>
<td>.131</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE4</td>
<td>Group 1</td>
<td>68</td>
<td>1.9118</td>
<td>1.129</td>
<td>.137</td>
<td>1.15</td>
<td>582</td>
<td>58</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>60</td>
<td>1.8000</td>
<td>1.054</td>
<td>.136</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE5</td>
<td>Group 1</td>
<td>68</td>
<td>2.4453</td>
<td>1.191</td>
<td>.144</td>
<td>1.01</td>
<td>288</td>
<td>-1.84</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>60</td>
<td>2.8500</td>
<td>1.039</td>
<td>.134</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE6</td>
<td>Group 1</td>
<td>68</td>
<td>3.2676</td>
<td>1.118</td>
<td>.136</td>
<td>1.17</td>
<td>852</td>
<td>2.25</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>60</td>
<td>2.9332</td>
<td>1.036</td>
<td>.138</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE7</td>
<td>Group 1</td>
<td>68</td>
<td>2.2053</td>
<td>1.259</td>
<td>.162</td>
<td>1.18</td>
<td>505</td>
<td>-2.93</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>60</td>
<td>2.0167</td>
<td>1.208</td>
<td>.177</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FU1</td>
<td>Group 1</td>
<td>68</td>
<td>3.8824</td>
<td>690</td>
<td>.108</td>
<td>1.06</td>
<td>778</td>
<td>7.7</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>Group 2</td>
<td>50</td>
<td>3.7627</td>
<td>855</td>
<td>.112</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### T-tests for independent samples of OR RESEARCH-DEFINED GROUP

**GROUP 1 - OR EO 1: APPLIED ARTS & SCIENCE FACULTY**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
<th>F 2-tail Value</th>
<th>Value Prob</th>
<th>Degrees of 2-tail Value</th>
<th>Freedom Prob</th>
<th>Pooled Variance estimate</th>
<th>Degrees of 2-tail Separate Variance Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FU2</strong></td>
<td>GROUP 1</td>
<td>68</td>
<td>1.7784</td>
<td>.750</td>
<td>.081</td>
<td>1.43</td>
<td>126</td>
<td>.060</td>
<td>- .82</td>
<td>115.58</td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>60</td>
<td>1.8000</td>
<td>.896</td>
<td>.116</td>
<td>1.85</td>
<td>126</td>
<td>.006</td>
<td>4.10</td>
<td>125.56</td>
</tr>
<tr>
<td><strong>FU3</strong></td>
<td>GROUP 1</td>
<td>68</td>
<td>3.1176</td>
<td>1.185</td>
<td>.141</td>
<td>1.85</td>
<td>126</td>
<td>.006</td>
<td>4.10</td>
<td>125.56</td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>60</td>
<td>2.3333</td>
<td>.668</td>
<td>.125</td>
<td>1.20</td>
<td>126</td>
<td>.471</td>
<td>3.07</td>
<td>120.36</td>
</tr>
<tr>
<td><strong>FU4</strong></td>
<td>GROUP 1</td>
<td>68</td>
<td>2.7059</td>
<td>.988</td>
<td>.120</td>
<td>1.20</td>
<td>126</td>
<td>.471</td>
<td>3.07</td>
<td>120.36</td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>60</td>
<td>2.7667</td>
<td>1.079</td>
<td>.136</td>
<td>1.20</td>
<td>126</td>
<td>.471</td>
<td>3.07</td>
<td>120.36</td>
</tr>
<tr>
<td><strong>FU5</strong></td>
<td>GROUP 1</td>
<td>67</td>
<td>2.8955</td>
<td>1.061</td>
<td>.130</td>
<td>1.57</td>
<td>126</td>
<td>.084</td>
<td>.49</td>
<td>122.25</td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>58</td>
<td>2.8103</td>
<td>.847</td>
<td>.111</td>
<td>1.57</td>
<td>126</td>
<td>.084</td>
<td>.49</td>
<td>122.25</td>
</tr>
<tr>
<td><strong>FU6</strong></td>
<td>GROUP 1</td>
<td>68</td>
<td>2.5882</td>
<td>1.040</td>
<td>.126</td>
<td>1.12</td>
<td>126</td>
<td>.659</td>
<td>- .53</td>
<td>125.39</td>
</tr>
<tr>
<td></td>
<td>GROUP 2</td>
<td>60</td>
<td>2.6803</td>
<td>.553</td>
<td>.127</td>
<td>1.12</td>
<td>126</td>
<td>.659</td>
<td>- .53</td>
<td>125.39</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY


