COOPERATIVE RESEARCH CENTER DIRECTORS: IMPORTANCE AND SATISFACTION OF FACTORS IN THE WORK ENVIRONMENT RELATED TO ORGANIZATIONAL PERFORMANCE

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

Beverly Rzeminski Kraska, B.A., M.A.
Denton, TX
May, 1989
Kraska, Beverly Rzeminski, Cooperative Research Center Directors: Importance and Satisfaction of Factors in the Work Environment Related to Organizational Performance.

Doctor of Philosophy (Higher and Adult Education), May, 1989, 204 pp., 22 tables, bibliography, 75 titles.

This study explored the importance attached to and the degree of satisfaction with 53 job aspects in the work environment of cooperative research center directors. A survey instrument was mailed to the 105 individuals identified as directors of research units that are (a) committed to multidisciplinary or engineering research, (b) organized as integral units of a university, and (c) supported and funded by industry and other sources. Responses were categorized into two groups: directors involved in NSF (National Science Foundation) Industry/University Cooperative Research Centers (I/UCRC), and directors involved in other types of cooperative research endeavors. A 69% response rate was obtained.

One purpose of this study was to measure: (a) factors that influence job satisfaction; (b) factors likely to influence center performance; and (c) success factors in industry/university cooperative research. This study was also designed to: (a) compare job attitudes between the two groups of directors; (c) determine the relationship between
measures of importance and satisfaction for each group; and
(d) develop predictive models of centers' performance using
collected data.

Directors assign a high degree of importance and a low
degree of satisfaction to the majority of the job aspects;
and they tend to be somewhat dissatisfied with those factors
they consider most important in their work environment.
Directors in the NSF I/UCRC group rated factors related to
professional activities and industry/university interactions
as significantly more important. In developing models to
predict the total operating budget and the number of in-
dustrial members at a center, combinations of importance and
satisfaction ratings were found to be significant factors.
# TABLE OF CONTENTS

**LIST OF TABLES** ........................................... V

**Chapter**

1. **INTRODUCTION** .......................................... 1

   - Statement of the Problem
   - Purposes of Study
   - Research Questions
   - Background and Significance of Study
   - Definition of Terms
   - Procedures for Collecting Data
   - Summary
   - Bibliography

2. **REVIEW OF RELATED LITERATURE** ...................... 22

   - Attitudes in the Work Environment
   - Determinants of Job Satisfaction
   - Factors Likely to Influence High Research Performance
   - Issues in the Management of Research Centers
   - Success Factors in Industry/University Cooperative Research
   - Summary
   - Bibliography

3. **DATA COLLECTION AND ANALYSES** ...................... 65

   - Target Population
   - Development of Survey Instrument
   - Description of the Survey Instrument
   - Procedures for Data Collection
   - Analyses of Data
   - Delimitations and Limitations of Study
   - Summary

4. **PRESENTATION AND ANALYSIS OF THE DATA** .......... 87

   - Introduction
   - Survey Results
   - Demographic Comparisons
     - Center Directors
     - Center Structure
   - Research Question I
Most Important Job Aspects Compared with Satisfaction Scores
Research Question II
Most Satisfying Job Aspects Compared with Importance Scores
Research Question III
Least Satisfying Job Aspects Compared with Importance Scores
Research Question IV
Comparison of Importance Scores Between Groups
Research Question V
Comparison of Satisfaction Scores Between Groups
Research Question VI
Importance/Satisfaction Correlations
Research Question VII
Importance as Predictor of Center Performance
Research Question VIII
Satisfaction as Predictor of Center Performance
Research Question IX
Combinations of Importance/Satisfaction Ratings as Predictors of Center Performance

Summary
Bibliography

V. SUMMARY, DISCUSSION, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH ...

Summary
Findings
Discussion of Data Findings
Conclusions
Implications
Recommendations for Future Research
Bibliography

APPENDIX A: PROPOSED SURVEY INSTRUMENTS ...

APPENDIX B: FINAL VERSION OF SURVEY INSTRUMENT AND LETTERS TO DIRECTORS ...

APPENDIX C: FACTOR ANALYSIS OF 53 JOB ASPECTS ...

APPENDIX D: IMPORTANCE/SATISFACTION RATINGS ...

BIBLIOGRAPHY ...
<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. University Ranking Based on R&amp;D Expenditures</td>
<td>90</td>
</tr>
<tr>
<td>2. Years and Types of Work Experiences of Center Directors</td>
<td>92</td>
</tr>
<tr>
<td>3. Time Devoted to Various Job Activities</td>
<td>94</td>
</tr>
<tr>
<td>4. Classification of Centers Based on Total Operating Budget</td>
<td>96</td>
</tr>
<tr>
<td>5. Human Resources Associated with the Center</td>
<td>97</td>
</tr>
<tr>
<td>6. Industry Likely to Support Research Emphasis</td>
<td>98</td>
</tr>
<tr>
<td>7. Number of Industrial Members</td>
<td>99</td>
</tr>
<tr>
<td>8. Most Important Job Aspects Compared with Satisfaction Scores</td>
<td>100</td>
</tr>
<tr>
<td>9. Additional Job Aspects Rated Important by the NSF Group Compared with Satisfaction Scores</td>
<td>107</td>
</tr>
<tr>
<td>10. Most Satisfying Job Aspects Compared with Importance Scores</td>
<td>109</td>
</tr>
<tr>
<td>11. Least Satisfying Job Aspects Compared with Importance Scores</td>
<td>111</td>
</tr>
<tr>
<td>12. Comparison of Importance Scores for Key Elements Between NSF and Non-NSF Group</td>
<td>115</td>
</tr>
<tr>
<td>13. Comparison of Satisfaction Scores of Key Elements Between NSF and Non-NSF Group</td>
<td>118</td>
</tr>
<tr>
<td>14. Importance/Satisfaction Correlations for Key Elements by Group</td>
<td>120</td>
</tr>
<tr>
<td>15. Predictive Model of Total Operating Budget Using Importance and Satisfaction Ratings</td>
<td>122</td>
</tr>
<tr>
<td>16. Predictive Model of Industrial Membership Using Importance and Satisfaction Ratings</td>
<td>123</td>
</tr>
</tbody>
</table>
17. Predictive Model of Total Operating Budget Using Combinations of Importance and Satisfaction Ratings . . . . . . . . . . . . . . . . . . . . 126

18. Predictive Model of Industrial Membership Using Combinations of Importance and Satisfaction Ratings . . . . . . . . . . . . . . . . . . . . 128

19. Importance Scores Compared with Satisfaction Scores for Directors in NSF Centers. . . . . . . . . . . . . . . . . . . . . . . . . . . 186

20. Satisfaction Scores Compared with Importance Scores for Directors in NSF Centers. . . . . . . . . . . . . . . . . . . . . . . . . . . 184

21. Importance Scores Compared with Satisfaction Scores for Directors in non-NSF Centers. . . . . . . . . . . . . . . . . . . . . . . . . . . 192

22. Satisfaction Scores Compared with Importance Scores for Directors in non-NSF Centers. . . . . . . . . . . . . . . . . . . . . . . . . . . 195
CHAPTER I

INTRODUCTION

The important role played by workers' attitudes in determining their actions in job situations was first recognized by Frederick Taylor in 1912 (Locke, 1976). When organizations accepted the idea that workers have minds and that workers' appraisals of the work situation affect their reactions to it, attitudes relating to job satisfaction became one of the most widely studied variables in organizational behavior. Job satisfaction is defined as "a pleasurable or positive emotional state resulting from the appraisal of one's job or job experience" (Locke, 1976, p. 1300).

Industrial and organizational psychologists have focused on what causes some employees to be more satisfied, work better, and remain at their institutions longer than other employees. The reason for this emphasis has been the anticipated benefits from a satisfied, hard-working, committed work force. Research suggests that job satisfaction ultimately leads to higher productivity, profitability, and quality (Hackman & Oldham, 1976; Nathanson & Becker, 1973). Steers (1984) emphasized that "if attitudes do, in fact,
influence behavior, creating positive attitudes toward the job is of critical importance" (p. 424) especially to organizations that value their employees. Today, many organizations recognize that one of the challenges they face is to create a work environment where employees have positive attitudes about their jobs and their workplace.

According to Locke, Fitzpatrick, and White (1983), relatively few studies have addressed two important areas in higher education: (a) the work attitudes of college and university faculty; and (b) possible differences in job satisfaction between academic fields. Specifically, a review of the literature indicated a lack of empirical data that explored the work attitudes of academicians who direct science/engineering cooperative research centers. Organized research endeavors have been described as "separately incorporated activities that serve the scholarly needs of an academic community and are utilitarian, problem-focused and accountable to a sponsor" (Friedman & Friedman, 1984, p. 28). Since 1972, over 5,000 research centers have been established in colleges and universities in response to increased demands for the application of academic research to the social and technical problems of the nation (Ikenberry & Friedman, 1972).

One reason given for the increasing numbers of science and engineering cooperative research centers is the interest of both business and academia in strengthening their re-
search ties and interaction. To accomplish this, universities support and encourage the establishment of cooperative research relationships in many different forms including research centers and institutes, industry-sponsored contract research, and industry/university cooperative research centers (Johnson, 1984). This wide spectrum of arrangements and cooperation between industry and academia illustrates that there is no single, right approach to cooperative research ventures because needs and circumstances vary in both organizations (Cromie, 1983).

A necessary factor in establishing and managing industry/university cooperative research programs is a strong leader. Tornatzky, Hetzner, Eveland, Schwarzkopf, and Colton (1982) suggest that center directors must be established and respected scientists within the academic community, and also be familiar with, experienced in, and respected by the industrial community. Friedman and Friedman (1984) points out that the choice of the leader of an organized research unit is very important to the success of the organization. Hinrichs (1966) considers the quality of the human talent secondary to the physical and dollar resources and one of the most important resource factors in determining the success or failure of a particular institution or organization. It is widely accepted by both industry and academia that few such leaders are available. To discover possible reasons, it is essential to understand
how directors of cooperative research endeavors perceive their work environments and its purpose in order to assure their continued active participation.

Research shows that university professors are relatively satisfied with their profession (McKeachie, 1982; Robinson, Athanasiou, & Head, 1969; Willie & Stecklein, 1982). Immense intrinsic and extrinsic satisfaction is also reported by those involved in the scientific process (Dickinson, 1986; Tuttle, Pasternak, & Smith, 1987). However, experience shows that teaching or the scientific process alone do not guarantee that individuals will be satisfied with their work environments. Just any organization will not suffice as an environment in which to pursue a research career. Professors and researchers will weigh the style and structure of the workplace against personal and professional needs; this appraisal process will result in a positive or negative emotional state for the faculty members (Tuttle et al., 1987). Because of this appraisal process, higher education administrators must recognize that there is a need to manage the environment carefully in which professors, researchers, and center directors practice their professions.

Currently there is a lack of research that identifies the emotional states or attitudes of directors to their work environment. According to Tornatzky et al. (1982), the academic professors who choose to direct centers must be
managers, leaders, researchers, teachers, negotiators, and marketers. The recent growth in the number of established organized research units suggests that these types of activities are attractive to a certain number of academicians. Wilson (1979) states that one reason academic cooperative research centers have proliferated was that this opportunity "accommodates the interest of academic innovators who prefer 'an end run' to launch programs rather than working through normal structures" (p. 86).

Baldwin and Blackburn (1983) suggest that academic institutions evaluate the relationships between professors and their environments. Such an evaluation could then help administrators gain insights into those factors in the work environment that provide rewarding and satisfying opportunities for individuals who are willing to devote time and energy to academic tasks. And if there are specific benefits, such as increased center research productivity, to be gained from center directors who are satisfied with their work environment, then directors' attitudes are worth of study.

Attitudes in the work environment create an important force that shapes and modifies behavior; the results lead to the accomplishment of organizational goals and effective performance. (Hinrichs, 1966). Literature and research (Friedman & Friedman, 1984; Gray, Hetzner, Eveland, & Gidley, 1986; & Johnson, 1984) explore several factors con-
sidered important to the viability, success, and performance of an organized research unit, but the importance of the directors' attitudes to center performance has not been established. While there are many possible measures of center performance, two measures mentioned as factors of successful research centers are used in this study to explore possible relationships between attitudes and center performance. The two measures of center performance are: total operating budget (Pelz & Andrews, 1966) and number of industrial members (Gray et al., 1986). Specifically, importance ratings, satisfaction ratings, combinations of importance and satisfactions ratings, and other collected center data are used in this study as variables in developing predictive models of center performance.

The business sector shows great interest in improving the work environment to achieve higher job satisfaction among employees because this effort provides potential benefits. In academia, studies focus on faculty with considerably less emphasis upon identifying the attitudes of center directors toward their work and work environment. Among the many programs organized to stimulate the interaction of university and industrial organizations in fundamental scientific and engineering research, the National Science Foundation (NSF) Industry/University Cooperative Research Program is especially well-known in business and academia as a model of successful industry/university re-
search cooperation (Gray et al., 1986). The attitudes of the center directors that operate under NSF policies and procedures are compared with a group of cooperative research centers who operate under various policies and procedures.

Statement of the Problem

The problem of this study is the importance attached to and degree of satisfaction with key elements in the work environments of cooperative research center directors with implications for the development of predictive models of organizational performance.

Purposes of the Study

The major purposes of this study are: (a) to measure the perceived importance of and degree of satisfaction with key elements in the work environments of NSF Centers Program directors and directors of cooperative research centers not in this program; (b) to compare the work attitudes of the two groups of directors; (c) to determine the relationship between the importance attached to and satisfaction with key elements in the work environment for each group; and (d) to develop predictive models of center performance using collected data.

Research Questions

Based upon the problem and purposes of this study, the following research questions focus primarily on describing the attitudes of two groups of center directors of cooper-
ative organized research units and developing a predictive model of center performance.

1. What degree of satisfaction with individual job aspects exists among directors of NSF industry/university cooperative research centers and other types of multidisciplinary/engineering cooperative research units?

2. How much importance do the directors in each group of cooperative research centers attach to individual job aspects that are the most satisfying?

3. How much importance do the directors in each group of cooperative research centers attach to individual job aspects that are the least satisfying?

4. Do differences exist in the importance attached to key factors in the work environment between the two groups of cooperative research center directors?

5. Do differences exist in the degree of satisfaction with key elements in the work environment between the two groups of cooperative research center directors?

6. What relationship exists between importance and satisfaction measures for the two groups of cooperative research center directors?

7. Can measuring the importance attached to key elements in their work environment by center directors predict center performance?
8. Can measuring the director's degree of satisfaction with key elements in the work environment predict center performance?

9. Can measuring combinations of importance and satisfaction ratings with key elements in the work environment predict center performance?

Background and Significance of the Study

Adequate resources are vital to the success of any organization. In labor-intensive enterprises like higher education, productive and effective human resources are essential. In universities, personnel decisions commonly focus on establishing rigid rules and terms of appointment; and after appointment tenure and promotion receive major attention. According to Baldwin and Blackburn (1983), academic personnel management neglects the areas of professional development and career opportunities. They also contend that many of the personal dimensions of faculty careers such as satisfaction and attitudes towards various responsibilities are frequently overlooked, and yet these factors impact faculty behavior and performance. Smith (1985) believes that a central challenge and responsibility facing university leadership is to recognize and to augment the growth, satisfaction, and enhancement of faculty members.
Providing career opportunities for faculty members is especially important in the area of science and engineering. The National Governor's Association (1983, p. 10) reported that there are approximately 1,650 academic vacant engineering positions across the country, creating heavy teaching loads. The Association also found that obsolete instrumentation is a major problem at many universities. When hiring and planning the style and structure of the research environment in the physical sciences, higher education administrators must consider three points: (a) that committed scientists and engineers operate in three research environments - industry, academia, and government; (b) that scientific researchers can and mostly do achieve a high degree of satisfaction because the value of their work and output is dependent on their own efforts (Dickinson, 1986); and (c) that satisfaction depends on harmony of individual goals and the research work environment (Pelz & Andrews, 1966). If administrators plan cooperative research center work environments with these points in mind, their efforts may provide the types of career opportunities that attract top researchers to academia.

In an industrial research environment, management recognizes "that a person who is happy in his/her work and derives satisfaction from doing it well, will work longer, harder, more efficiently and often for less money than another who is less satisfied" (Dickinson, 1986, p. 85).
Hulin (1986) reports that a company can study those factors that cause employee dissatisfaction and then change affected company policies in order to improve its annual turnover rate. While neither of these statements directly addresses the academic environment, both imply the benefits that can be derived from satisfied employees. If low turnover rates, efficient operations, and increased productivity are goals of higher education administrators, a priority for administrators should be to ensure that (a) the work environments of research center directors provide factors these faculty members consider important, and (b) there is agreement between what is desired by center directors and what the situation provides. This requires that administrators know what directors perceive as important in their work environments and the degree of satisfaction the directors associate with these factors.

While both universities and the NSF have established procedures for evaluating the efficiency and effectiveness of cooperative organized research units, Friedman and Friedman (1984) argue that a need exists to evaluate the center director's responsibilities because of the position's central role in success of the center. Directors of organized research units face (a) having the unique responsibility of developing and managing organizations without precedent on most campuses (Gray et al., 1986); (b) being unprepared for many of the new procedures, required tasks,
and activities required by their positions (Libby & Flick, 1969); and (c) spending part of their time managing (Orth, Bailey, & Wolck, 1964). From these statements, one can conclude that center directors may face many new challenges in accepting their positions. Recent empirical data about how directors feel about their work environments provides information about this topic from a new perspective, the directors' own analysis of their work situations.

In a recent study assessing the job satisfaction of research scientists, Tuttle et al. (1987) stated that research scientists generally place exceptional value on their work and they are able to achieve satisfaction from being involved in the scientific process. However, experience has also shown that the scientific process alone does not guarantee that researchers are satisfied with their work context. If they are not satisfied nor able to foresee that undesirable conditions will change, the probability increases that their work performance will suffer or that they will change their organizational affiliation. Hence, the job satisfaction of research scientists is a significant management problem. (p. 5)

Therefore, higher education administrators must understand that in order to attract and retain the best faculty members to direct the activities of science/engineering cooperative research centers, universities are challenged to manage the
factors influencing the job satisfaction of center directors.

The literature tends to describe the position of center directors generically: they are the faculty members who choose to manage and direct cooperative research centers. At the same time, the actual research cooperative centers themselves vary depending on the structure and organization of the center. This study is significant in that collects empirical data about the perceived importance of and degree of center director satisfaction with key elements in the work environment. Study data will determine if the directors of NSF Industry/University Cooperative Research Centers report attitudes typical of directors of other types of cooperative research centers. This study will then determine the relationship between what is desired by center directors and what the situation provides. And finally, since center performance is an important issue for the three financial support groups (university, industry, government) that support and direct center activities, this study will determine the relationship between directors' attitudes and organizational performance. For higher education administrators, this exploratory study measuring the work attitudes of center directors will attempt to provide insights into factors in the center environment, that when modified to the extent possible, may provide an improved work environment for academic entrepreneurs.
Definition of Terms

The following terms are defined as they relate to this study.

_attitudes_ are the beliefs held by an individual about another person or object and the affective responses to that person or object.

_centers_ are organized research units that serve as focal points for cooperative research activities. These units, often called institutes, or stations, are organized as integral parts of a university and have involvement with, support, and funding from industry and other sources.

_center directors_ are the individuals responsible for planning, organizing, directing and controlling the operations of organized cooperative research units; and they are involved in decisions regarding the center and its activities. Individuals, in dealing with professional and center activities, use this title or a similar title.

_key elements in the work environment_ refer to specific aspects of the job of center directors.

_performance_ will be measured using two criteria: (a) performance defined as the total operating budget divided by the number of faculty and non-faculty researchers; and (b) performance defined as the number of industrial members normalized for age of organized research unit (rationale for selecting these performance measures explained in Chapter 3).
Procedures for Collecting Data

Data were collected nationwide from directors who operate cooperative research units that: (a) have a multi-disciplinary or engineering focus; (b) are organized as an integral unit of a university; and (c) are supported and funded by industry and other sources. These directors were divided into two groups, directors of centers in the NSF I/UCRC program (NSF I/UCRC) and directors of centers not sponsored by the NSF Centers program (non-NSF I/UCRC).

Questionnaires were mailed to the directors of the thirty-eight National Science Foundation Industry/University Cooperative Research Centers. A report sponsored by the National Science Foundation, Structural Information for 1986, produced by Gray, Gidley, and Koesler at the University of North Carolina was used to obtain information about budgets, industry members, center staff, and time spent on various activities. The questionnaire was accompanied by a pre-addressed envelope and a personalized cover letter. A follow-up letter was sent to the directors who did not respond to facilitate gathering the total population defined in this study.

The survey instrument was also mailed to the 67 organized research units meeting the three criteria of this study listed in the 12th edition of Research Centers Directory, the non-NSF I/UCRC group. Included with the questionnaire was a data collecting form requesting informa-
tion about budgets, industry members, center staff, and time spent on various activities. The questionnaire and form were accompanied by a pre-addressed envelope and a personalized cover letter. A follow-up letter was sent to the non-respondents.

The questionnaire attempted to measure work attitudes and to determine the relationship between what directors believe to be important in their work environment and their degree of satisfaction with these factors in their organization. Information about the center director and the structure of the center was also obtained. Responses from the survey instrument, demographic data, and center structure data were used to develop predictive models of center performance.

Treatment of Data

The survey instrument developed was the result of a review of the literature on attitudes in the work environment and cooperative research interactions. The survey was designed to produce information about the collective attributes of the targeted population and about what is true of the respondents regarding these attributes. The questionnaire was constructed to measure attitudes relating to job content, research factors, and management functions in the work environment of center directors likely to influence satisfaction and center performance. An information sheet requesting demographic data on the director and structural
information about the center accompanied the questionnaire. A preliminary survey instrument was sent to five National Science Foundation center evaluators to determine relevancy of the items and establish content validity of the questionnaire. This evaluation by the center evaluators resulted in a survey instrument that measures the importance attached to and degree of satisfaction with 53 job aspects. A factor analysis of the survey instrument data was performed. This analysis was based on the degree of importance of the job aspect and resulted in reducing the number of individual job factors to six key elements.

The targeted population of approximately 105 represents the entire group of directors who operate cooperative research units that: (1) have a multidisciplinary or engineering focus; (2) are organized as an integral unit of a university; and (3) are supported and funded by industry and other sources. This group was identified through listings in the 12th edition of Research Centers Directory and/or a directory maintained by the NSF of centers in the Industry-University Cooperative Research Centers program. Attempting to reach enough of this target group for a statistically significant sample resulted in the use of descriptive rather than inferential statistics. Therefore, characteristics and traits of the population of directors involved with organized research units meeting the criteria were measured and treated as descriptive data. A minimum response from 60
percent of the population was necessary for completion of the study.

Summary

Chapter I identifies the problems and purposes, lists the research questions, and explains the background and significance plus summarizes the procedures of this study. Chapter II reviews the relevant literature and Chapter III details the data collection process and the statistical procedures used.

Chapter IV presents the data analyses and findings. Chapter V includes a summary, findings, discussion, conclusions, implications and recommendations for future research.
CHAPTER BIBLIOGRAPHY


This review of the literature presents a range of related sub-topics drawn from the overall discussion of attitudes in the work environment and industry/university cooperative research interactions. For purposes of organizing and presenting a comprehensive view of the main topic, this chapter is divided into five relevant aspects that include: (a) attitudes in the work environment; (b) determinants of job satisfaction; (c) factors likely to influence high research performance; (d) issues in the management of research centers; and (e) success factors in industry/university cooperative research.

**Attitudes in the Work Environment**

A widely discussed aspect of organizational life is job attitudes. In *High-Talent Personnel*, Hinrichs (1966) suggests that attitudes regarding work and the perception of one's work role can be an important force in shaping behavior toward the attainment of organizational goals. Attitude, a psychological construct, is defined as "a predisposition to respond in a favorable or unfavorable way to objects or persons in one's environment" (Steers, 1984,
Constructs are ways of conceptualizing intangible elements; and while the consequences of an attitude may be observed, the attitude itself cannot be observed or measured directly. Attitudes are unidimensional variables that can be assessed along an evaluative continuum that includes a range, such as "very important to very unimportant" or "very satisfied to very dissatisfied" (Mueller, 1986).

The attitude construct has been described in two ways. Triandis (1971) describes it as having three components: (a) the beliefs a person has about a certain person or object, the cognitive component; (b) the feelings a person has about a certain person or object, the affective component; and (c) the behavioral intentions a person has towards the person or object as a result of the affective response. Fishbein and Ajzen (1975) describe attitudes as affective responses. They also argue that cognitive responses, or beliefs, are antecedents of the attitude, while behavioral intentions are considered outcomes of attitudes.

Special attention is given to two relationships in the attitude models presented. In Measuring Social Attitudes, Mueller (1986) points out that actual behaviors are influenced by many things besides attitudes, and that therefore attitudes are sometimes inaccurate indices of behavior. Steers (1984) suggests that factors like personality, experiences, external control and past and current conditions weaken the impact of attitudes on behavior. Also, des-
criptions of the attitude construct suggest that beliefs influence attitudes. According to Ebert and Mitchell (1975), a belief may be defined as a perceived relationship between people, objects, and events. And while beliefs may not actually be correct or accurate, the individual is convinced they are true. Four processes are believed to influence the forming of beliefs: (a) past experiences; (b) available information about a particular issue; (c) generalizing from similar situations, events, or objects; and (d) influencing effects of individuals in whom we have confidence (Sarbin, Taft, & Bailey, 1960).

Many studies in organizational behavior focus upon beliefs, attitudes, behavioral intentions and actual behavior of employees in the work environment. Management considers attitudes relating to job satisfaction particularly important. According to Steers (1984),

Job satisfaction brings with it a variety of positive consequences, both from individual and organizational standpoints. It influences how an employee feels about the organization and contributes to the desire to maintain membership in it. It spills over to affect an employee's home life and general outlook toward living. Moreover, job satisfaction significantly influences how people approach their jobs, their level of effort and commitment, and their contribution to organizational effectiveness. (p. 442)
Various approaches to understanding job satisfaction have developed. Content theories of job satisfaction attempt to identify the specific needs that must be satisfied, or the values that must be attained, for individuals to achieve job satisfaction. Process theories maintain that job satisfaction is determined not only by the nature of the job and its context, but also by personality variables such as the worker's needs, values and expectations. Further, process theories attempt to distinguish which and how mental processes combine to determine job satisfaction (Locke, 1976). Whichever approach one uses, an important consideration is the identification of need types or attitude referents about which an individual feels satisfied or dissatisfied (Steers & Porter, 1975).

Much work satisfaction research argues that satisfaction depends on the extent outcomes (which individuals perceive they receive from their work environment) correspond with what individuals are pursuing (in the work environment). In other words, satisfaction is seen as a measure of discrepancy between expectations and outcomes. The larger the distance between the pursued outcomes and the perceived outcomes in the work environment, the lesser the degree of satisfaction (Thierry & Koopman-Iwema, 1984). In short, process theories describe job satisfaction as a function of the extent of the discrepancy between what the job offers and (a) what the individual expects, (b) what the individual
needs, or (c) what the individual values.

Rather than focus on the discrepancy between pursued and perceived outcomes, other research focuses on congruency of expectations met. Porter and Steers (1973) suggest that individuals bring to the employment situation their own unique set of expectations. In their view, job satisfaction becomes the sum total of an individual's met expectations on the job, or the congruency between what is expected and what is received. A point is made that "Whatever the composition of the individual's expectation set, it is important that those factors be substantially met if the employee is to feel it is worthwhile to remain with the organization" (p. 175).

In a similar vein, Lawler (1973) theorizes that the degree to which the job fulfills, or allows fulfillment of, the individual's needs determines the degree of job satisfaction. Needs, or outcomes, that are preferred by individuals are considered rewards. If the intrinsic rewards, those that are part of the job and occur when the employee performs the work, and the extrinsic rewards, those that are administered by others, are received and distributed fairly, the employee experiences job satisfaction.

According to Locke (1976), job satisfaction is "the pleasurable emotional state resulting from the perception of one's job as fulfilling or allowing the fulfillment of one's important job values, providing these values are compatible
with one's needs" (p. 1342). Locke argues that most re-
searchers fail to adequately specify or define the concept
of need. He states that values, which represent human wants
and preferences, are what an individual seeks to fulfill.
Consequently, Locke developed Theory V (for value), pro-
posing that job satisfaction was not the simple sum of
satisfaction with individual elements of the job. This
theory argues that it is more reasonable to expect that the
relative importance of each of the factors also plays a role
in one's overall level of satisfaction.

In an analysis of the satisfaction of scientists in or-
ganizations, Pelz and Andrews (1966) report that high per-
formers were generally satisfied, but that there are also
several instances of dissatisfaction with specific job
aspects. In this study, two components define satisfaction:
the strength or importance of a factor and the degree to
which the desired factor is actually present. The degree of
discrepancy between the two generates the feeling of satis-
faction or of dissatisfaction with specific job aspects.

The concept that satisfaction depends on the agreement
between what is desired by employees and what the situation
provides is also described as the congruency between the
interests of individuals and the interests of the organiza-
tion. Business faculty members (n = 332) teaching in 15
Canadian universities ranked the importance of job aspects
and their degree of satisfaction with these factors, using
their current position as a frame of reference. Negative correlations exist between importance and satisfaction measures indicating that the faculty tend to be less satisfied with the job characteristics they perceive as most important (Hurka, 1978).

The influence of perceived importance on individual job aspects is the focus of an exploratory study of 498 university and community college faculty members by Locke, Fitzpatrick, and White (1983). A major finding of this study indicates that faculty members are satisfied to the degree that they obtain what is important to them from their work environment. As might be expected, this study also confirms that the more important the faculty perceives the job aspect, the more effect that aspect has on overall job satisfaction.

A recent study of 1560 industrial workers (Khaleque & Rahman, 1987) proposes that overall job satisfaction depends on satisfaction with the number of job facets as well as their perceived importance. This study confirms findings of other studies (Blood, 1971; Ewen, 1967) that the degree of overall job satisfaction increases not only when satisfaction with the important job components exists, but also with the satisfaction of an increasing number of job facets, irrespective of their perceived importance.

Other studies (MacQueen, 1986; Mikes & Hulin, 1968) indicate that when job facet satisfaction scores are
weighted by importance, this procedure does not result in a better indicator of overall job satisfaction than when using only the unweighted job facets. These studies concluded that weighting job facets with importance weights is unnecessary when determining overall job satisfaction.

The results of a study by Hinrichs (1966) indicate that professionals are able to conceptualize their major goals and to evaluate the importance they attach to various work components. Hinrichs' study involves a group of 567 technically oriented professionals and uses an 11 point scale to determine the importance of 52 job aspects. The participants assigned the highest rankings to personal success and achievement, intrinsically challenging work, and company identification. Middle rankings of importance were given to money, working in a congenial atmosphere, and upward influence. Those factors relating to authority and maintenance of status quo received the lowest ranking.

Numerous studies focus on monetary compensation as a value and satisfier in the work environment, which a person might assume would be a high ranking satisfaction determinant. Unfortunately, it is difficult to obtain good comparative data on academic and nonacademic compensation. However, the literature does suggest that the attraction of nonacademic jobs in science and engineering are influenced more by better long-range salary possibilities, career prospects, and working conditions than by higher starting
salaries. In many cases, industry jobs offer better facilities and support for advanced research than academic jobs (Smith, 1985).

Determinants of Job Satisfaction

The variable job satisfaction can be treated as a single dimension or a set of dimensions depending on the purpose of the study. Vroom (1964) suggests that general job satisfaction might be of most value in predicting behavior in relation to the work role as a whole, or actions that lead a person toward or away from the job. On the other hand, satisfaction "with particular sets of properties of the work role might be of value in predicting how employees would respond to changes in work roles as well as the degree to which they might seek to initiate changes on their own" (Vroom, 1964, p. 101). According to Locke (1976), a job must be analyzed in terms of its elements because a thorough understanding of job attitudes requires examination of the complex interrelationships of tasks, roles, responsibilities, interactions, incentives and rewards.

Porter and Steers (1973) suggest that influences on employee attitudes can be grouped into four relatively discrete categories, representing four levels in the organization. These four groups include: (a) organization-wide factors, (b) immediate work environment or job context factors, (c) job content factors or the actual job activities, and (d) personal factors. Locke (1976) separates the
job dimensions that influence employee satisfaction into two different categories: events or conditions and agents. Locke isolated six event elements, which are work, pay, promotions, recognition, benefits, and working conditions. The three agent elements Locke identifies include supervisor, co-workers, and company/management.

Locke et al. (1983) states that one of the major findings of their study is that faculty members generally want the same things in their jobs as employees in other types or organizations, i.e., a sense of achievement from their work, work role clarity, fair pay and promotions, good facilities, and administrators, chairpersons, and co-workers who facilitate the achievement of work related value and who are personally helpful, honest and respectful. (p. 359)

Factors that influence job satisfaction in business can provide valuable information to higher education administrators. At the same time, the academic work environment differs from business in a number of unique ways that must also be considered. Providing administrators insights into the relationship between professors and their academic organizations requires an understanding of the degree of faculty well-being and contentment in situations characterized by: (a) a conflict between teaching and research; (b) a dual, institutional and professional orientation; (c) the tenure system; and (d) a high degree of autonomy (Light,
1974).

The relationship between professors who assume the responsibilities of directing a university-based research center and the academic organization has not been explored. It can be assumed that many of the actual job activities of a center director differ somewhat from other faculty positions. These specific work or job content factors that influence satisfaction are the main focus of this study. The amount of variety, autonomy, responsibility, and feedback provided, or the job scope, strongly influences satisfaction (Stone, 1978; Brief and Aldag, 1975). Individuals want to feel their work and their actual job activities give them the opportunity to use their valued skills and abilities. They also want to feel a sense of achievement, success and accomplishment, and progress towards a goal which was facilitated by feedback. For professionals (including faculty), work achievement factors, responsibility for decisions, and the amount of work are important correlates of satisfaction (Locke et al., 1983; Nicholson & Muljus, 1972).

Faculty members find freedom and autonomy satisfying (Eckert & Stecklein, 1981); and they prefer independent intellectually stimulating activities (Ladd & Lipset, 1976). Deci and Ryan (1982) find that satisfaction tends to be more highly influenced by factors inherent in the activities themselves and that satisfaction was facilitated when such
opportunities were present. Additionally, extrinsic factors such as working conditions and administrative policies, or factors controlled by others, are more likely to be sources of faculty member dissatisfaction.

At the faculty or professional job level, the influence of intrinsic factors on satisfaction may be explained by the fact that there are important differences between job levels in the meaning of work with the lower levels more often viewing work only as a means to keep busy or to earn a living while the higher level workers more often view it as pleasurable in itself and as a means of fulfilling a variety of psychological needs. (Locke, 1976, p. 1321)

Other significant factors which lead to reduced job satisfaction are role ambiguity and role conflict (Miles & Perreault, 1976; Schuler, 1980). Role clarity, situations in which employees know what is expected of them or where they have clear tasks goals, strongly influence satisfaction. Clarity involves defining the actual job activities and is facilitated by company/management policies. If role clarity is not present, Schuler (1980) suggests that individuals may experience either role ambiguity or role conflict. Role ambiguity results when role expectations are unclear or poorly defines. whereas role conflict occurs when the role expectations either are incompatible or contradict
the individual's own needs, values, or expectations.

Inherent conflicts and ambiguities in the academic role have been studied. Light (1974) describes a university setting as one of very high autonomy and responsibility combined with performance appraisal criteria only partially specified. Locke et al. (1983) find that work role clarity factors include work feedback, clear expectations, consistent expectations among different people, participation in work-related decisions, and job description clarity. All these factors are associated with work achievement satisfaction. In a study of 332 business faculty members in 15 Canadian universities, Hurka (1978) finds that of the nine more important job characteristics, only three receive a relatively high satisfaction score: (a) teaching, (b) non-directive deans, and (c) national recognition.

In addition, satisfaction is influenced by co-workers, recognition, and company/management (job aspects also included in this study). Kurth & Mills (1968) find faculty satisfaction to be associated with two areas: (a) the "fruits of their labor" including personal satisfaction and enjoyment of teaching; and (b) the environment in which faculty work, including independence of work and competency of colleagues. The main sources of dissatisfaction associated with the work itself include poorly motivated students and administrative procedures.

One major factor relating to job satisfaction is per-
sonal recognition in the work place which serves various functions. It provides feedback concerning the competence of one's job performance, it influences job satisfaction and dissatisfaction, and it augments self-esteem for those desiring the approval of significant others. Individuals with low self-esteem are most emotionally affected, both positively and negatively, by recognition (Locke, 1976).

Another significant factor on an inter-personal level relating to satisfaction is co-worker relations (Ladd & Lipset, 1976). As might be expected, people are generally attracted to and feel more comfortable with co-workers exhibiting characteristics, interests, and beliefs similar to their own (Locke, 1976). Furthermore, stimulation and intellectual interchange with colleagues and graduate students is rewarding for faculty (Eckert & Stecklein, 1981).

In summary, the most important conditions conducive to job satisfaction include: (a) mentally challenging work with which the individual can cope successfully; (b) working conditions which facilitate the accomplishment of work goals; (c) high self-esteem on the part of the individual; and (d) agents in the work situation who can assist the employee attain job values (Locke, 1976).

Factors Likely to Influence High Research Performance

Throughout the higher education environment, research is typically desired and admired. For the faculty member,
research productivity provides better insight in a discipline and contributes to developments that can enhance teaching effectiveness. Scholarly productivity provides visibility and enhances a university's reputation, factors that are valued by administrators and trustees. Deans admire productivity for the creative, stimulating forces it brings into the collegial atmosphere. And the advancement of knowledge is valued by the academic community (Creswell, 1985).

Whether or not faculty themselves engage in research, they believe that a most important activity for an academic person is the performance of significant research (Ladd, 1979). Research, directed and conducted by the members, is a major function of cooperative research units. One of the objectives of the National Science Foundation (NSF) Industry/University Cooperative Research Centers (I/UCRCs) is to pursue fundamental engineering and scientific research having industrial relevance. While research activity is difficult to assess, the outcomes or the performance of research are often evaluated. Of the various measures of research performance, the most common are publication counts, citation counts, and ratings by peers and colleagues (Yuker, 1978).

A number of studies focus on factors that influence high research performance, and research offers several explanations of why some faculty become prolific re-
searchers. A profile of productive researchers emerges from numerous correlate studies done during the past 40 years. Two profile characteristics are: (a) employment in a major university that rewards research and assigns ample time and facilities to conduct research, and (b) research activities accounting for at least 1/3 of an individual's time (Creswell, 1985). Finkelstein (1982) states that a productive researcher "spends more time in research, less time in teaching, and is not overly committed to administrative chores" (p. 98).

Research on why some faculty excel in research performance focus on four different explanations. Influences studied include gender, age, innate scientific ability, stress, personality characteristics and motivation. One idea explored is that many faculty engage in research because they have a strong inner compulsion or motivation for this type of activity. Jonathan Cole and Stephen Cole (1973) refer to this trait as a "sacred spark."

Another explanation for research productivity describes performance as a cumulative advantage based on tangible resources. Merton (1973) argues that once scientists receive resources from their initial work, their research position and environment or their association with respected colleagues in the field, tends to accrue additional advantages as they progress through their careers. The effects of variables such as the prestige of the doctoral program,
mentoring, prestige of the employing institution, resources, and assignments receive study because of the belief that these factors accumulate and contribute to high levels of productivity (Creswell, 1985).

Additionally, high performance levels can also result from the positive reinforcement some faculty receive for their efforts. Gaston (1978) states that feedback from successful publication of works, works being cited, and formal and informal praise from colleagues stimulated further work. Contributing significantly to productivity is the informal recognition offered researchers by colleagues, due to the immediate reinforcement; this impacts productivity even more than the delayed feedback of published work or work cited (Reskin, 1977). Reinforcement variables believed to influence research performance include colleagues, academic rank and tenure, early productivity, and preference for research. Because of the strong positive relationship between the measures of reinforcement and high performance levels, Creswell (1985) states that reinforcement may be the most important explanation of research performance.

One final explanation given for variation in research performance is the norms of a field of study and the scientific knowledge in a discipline. Physical sciences are considered "mature" fields which provide suggestions on which problems require investigation next, what methods are appropriate to their study, and which finds are considered
proven. This maturity permits defined research objectives (Lodahl & Gordon, 1972).

Creswell (1985) organizes the correlates of faculty research productivity into the following categories: (a) given or ascriptive factors, (b) individually controlled factors, and (c) institutionally controlled factors. He suggests that faculty can influence their own research performance by controlling certain variables, such as maintaining a continuous line of research during their careers and maintaining research contacts with individuals pursuing similar research within and outside the immediate work environment. He also suggests that administrators can enhance the research performance of faculty by assigning research time to their faculty load, by providing resources such as secretarial services, computer time and research assistants, and by providing appreciation and respect for the researcher's goals and objectives.

Institutionally controlled factors, such as organizational environments and incentive structures, also influence the research output at academic institutions. The article "Creating an Action Team in R&D" (1984), discusses the value of direct rewards of release time and allocation of resources research. This article concludes that while institutional incentives may induce faculty to undertake research the first time, direct rewards encourage research to continue. A number of direct awards prove more important
than institutional rewards, including the availability of research assistants, allowed travel and financing, the expected teaching loads as well as the mixture of undergraduate and graduate courses taught, the student/teacher ratio and the emphasis on research in evaluation and tenure considerations.

Pelz (1956) stresses not only the performance but the technical effectiveness of performance as an important factor in evaluating research. He finds that researchers who spend 3/4 time on research and 1/4 time on teaching are more effective technically. In addition, he concludes that students provide challenges by forcing research faculty to test and expand their ideas. Pelz suggests that the 1/4 time not devoted to research should be devoted to administration because this brings the researcher into direct contact with others not ordinarily encountered. The time spent on administration fosters communication and provides links prevented by the spatial and organization factors that result when other types of non-research activities are not available to the researcher.

Hinrichs (1966) stresses the interaction of the individual and the environment when he states that

If the conditions under which the scientist work do not allow him intrinsic job satisfaction, then providing him with the finest equipment and facilities may not stimulate him to produce. On the other hand, even the
most motivated of scientists are not likely to accomplish much if they are hampered by a severe lack of facilities to work with. (p. 203)

Issues in the Management of Research Centers

High-quality leadership and management of cooperative research units is absolutely critical to their ultimate success (Friedman & Friedman, 1984; Gray, Hetzner, Eveland, & Gidley, 1986; Peters & Fusfeld, 1983; Tornatzky, Hetzner, Eveland, Schwarzkopf, & Colton, 1982). Industry/university research endeavors are administratively complex organizations that must bridge the differing norms, procedures, and expectations of these two entities. In order to successfully establish a center,

a center director must be willing and able to meet the administrative challenge of creating and managing an organization within his or her university which probably has no precedent. In addition, that individual must be an established and respected scientist within the academic community and at the same time be familiar with, experienced in and respected by the industrial community. (Gray et al., 1986, p.183)

Planning, organizing, directing and controlling are management functions that assist an organization, including an organized research center, in its operations and activities. In planning, a manager outlines what the organiza-
tion must do to be successful. This function helps an organization define and meet its objectives. Organizing turns plans into actions and influences how efficiently and effectively things are done. Supervising and instructing those involved in an organization's activities is the directing function of management. The controlling function assures that the actual performance of an organization conforms to the performance planned (Ivancevich, Donnelly, & Gibson, 1984). A study of industry/university research connections by Peters and Fusfeld (1983), finds that although funds in support of university research are processed in offices separate from the activity, faculty scientists are responsible for management and administration of the joint programs.

Three managerial and leadership roles are mentioned as important to the success of a center. The first crucial role requires the development and maintenance of liaison relationships with industrial participants. The ability to communicate easily with industrial and academic scientists is considered essential. Communication skills are also important in negotiating and bargaining within the academic environment because a second important leadership role is the maintenance of relations with significant groups or individuals within the university. Since centers must maintain superior research performance, the third important management role is the "administration and supervision of
individual research projects including making sure they are on schedule, maintaining their industrial relevance, providing adequate logistical support, and attending to personnel issues" (Tornatzky et al., 1982, p 13).

The following points illustrate the challenges directors may encounter in accepting this role:
1. Tornatzky et al. (1982) report that the research management approach is not a common role within the university structure although its importance is widely recognized in industrial research. The fact that the lack of adequate research management is mentioned as a source of dissatisfaction among industries supporting NSF I/UCRCs is also reported. Therefore, the development of center directors, also referred to as research managers, is an important goal for research center sponsors. This objective is considered necessary because it is often difficult to find the type of individual needed inside the university itself.
2. Orth, Bailey, and Wolck (1964) state that the decision to become a manager is one of the most difficult career decisions for scientists.
3. The manager of an organized research unit may be unprepared for many of the new procedures, required tasks, and activities required in this position (Libby & Flick, 1969). One attribute needed to lead technical people in a research environment is technical talent. However, skill in marketing, finance, and employee relations are also necessary
attributes (Humphrey, 1987).

4. In industry, the ultimate research management responsibility normally resides at a level above the research scientist. This structural research management difference between academia and industry may cause frustrations and difficulties in cooperative research, at least in the initial stages (Peters & Fusfeld, 1983).

5. While industries are receptive to cooperative research endeavors, it is clear that the university is selling not receiving (Peters & Fusfeld, 1983). According to Gray et al., (1986) "if a center wants to stay in business, it is critical that it perceives industrial recruitment as an ongoing and not a one-time obligation" (p 183). Wilson (1979) states that one effect of university/industry cooperative research was a dependency of research centers on external funding that requires center directors to spend considerable effort in promotion.

In spite of all the possible barriers directors may encounter in developing and managing a cooperative research center, for many university researchers this role is perceived to be a desirable one. According to Wilson (1979), directing a research environment can be an appealing career opportunity for academic researchers, since it offers: (a) an opportunity to pursue academic research outside of the conventional department structure; (b) an entrepreneurial structure for those prefer this type of inter-
action; and (c) a quicker response to external opportunities than possible through normal mechanisms. This appeal may be explained by the fact that

Professional people want to be productive; therefore they seek the satisfaction of accomplishment and the rewards of recognition. These, however, only come with some of the jobs, and they quickly discover that they must get the right assignments in order to make progress. This one fact explains why so many engineers and scientists move into management: to have more control over their own destiny. (Humphrey, 1987, p. 36)

At the same time, managing a cooperative research center and maintaining superior center research performance can prevent directors from pursuing their own research projects. It is difficult for the scientist turned manager to put in time at the bench conducting research. Time devoted to performance of laboratory work detracts from managerial time (Libby & Flick, 1969). Another factor blocking scientific research time results from successful projects; the scholars are deluged with research funds. Consumed with administrative duties, they never find their way back to the laboratory (Pelz, 1956). If the cooperative research endeavor is successful, a director may experience this lack of individual research time. A Parkinson Law of academic research reads "Successful research attracts the bigger grant which makes further research impossible"
(Eurich, 1967, p. 5). These factors cause conflict for those directors who list research time an important factor in their work environment.

While similarities exist in managing research in industry and managing research in academia, the two positions are also very different. Given current academic structural constraints, it would be difficult for the academic community to accept a point made by Libby and Flick (1969) in dealing with the successful conversion of the scientist-turned-manager. Addressing the industrial research environment, they emphasized that

Management has not fully realized that the desire of a scientist-manager to stay at the bench while still managing must be suppressed. It should be emphasized that a scientist cannot jealously guard his reputation as an expert while managing multidisciplinary programs without reducing his effectiveness as a manager. (p. 44)

Success Factors in Industry/University Cooperative Research

A 1983 study of current industry/university research interactions, describes cooperative research as an activity where the parties plan their research, the program goals, and the disposition of the outcomes to varying extent. This study finds a surge in the number and variety of university/industry research interactions, listing 463 research ties between industry and universities with 51%
less than 3 years old. (Peters & Fusfeld, 1983).

Johnson (1984) describes cooperative research centers as "multiorganizational, multipurpose, and jointly planned and/or managed endeavors focusing on research and related activities of mutual interest" (p. 33). Variously named centers, bureaus, institutes or laboratories, cooperative research ventures serve as a focal point for special research interests and activities. In describing these organizations, Peters and Fusfeld (1983) states that

The general nature of cooperative research is to develop a basis for orderly flow of scientific and technical information on several levels in order to acquire new ideas or accomplish a specific objective through broader inputs, and to provide the foundation for future technical programs. (p. 17)

Universities support cooperative research relationships in many different forms, including research centers and institutes, industry-sponsored contract research, and industry/university cooperative research centers (Johnson, 1984). The wide spectrum of arrangements and cooperation between industry and academia illustrates that there is no single, right approach to cooperative research ventures because needs and circumstances vary (Cromie, 1983).

In 1973, the NSF initiated the Industry/University Cooperative Research Center (I/UCRC) Program to stimulate the interaction of university and industrial organizations
in fundamental scientific and engineering research and to improve the linkage between universities and industrial firms. NSF believes that this relationship is important for technological innovation and industrial development. In helping to establish such research centers, NSF provides seed money to aid the center commence its research program. The objective is to encourage industry to join the program and provide increasing support. After a period of five years, it is expected that companies, universities, and states will support and finance center operations completely.

An I/UCRC is a "university-based, typically interdisciplinary program of research supported jointly by a number of companies" (Tornatzky, Eveland, Hetzner, Johnson, Roitman, & Schneider, 1983, p. 34). Structurally and operationally, these centers represent a relatively standardized organizational model. I/UCRCs have: (a) an administrative function reporting to a departmental administrator; (b) an academic advisory committee; (c) an industrial advisory board; and (d) an evaluator to assist in gathering data about center operations and research outcomes (Gray et al., 1986).

The NSF industry/university cooperative research program activity has grown from eight awards totalling $1.4 million in 1978 to 79 awards totalling approximately $7-8 million in 1980 (Peters & Fusfeld, 1983). Thirty-eight NSF
I/UCRCs operated in 1987. Approximately 20% of I/UCRCs have experienced leadership changes; at least 12 individuals decided, for one reason or another, to relinquish the directorship of their center (A. Schwarzkopf, personal communication, November 6, 1987). Peters and Fusfeld (1983) report that the most critical factor in successful center development seems to be an employing an energetic leader with a sense of direction. In this study, one center reviewed was unsuccessful. The reasons given included: (a) absence of a strong faculty leader; (b) administrators structured the program (faculty played a secondary role); and (c) the industrial sector was extremely fragmented.

Though a wide spectrum of cooperative research ventures exist, characteristics of successful programs are identified. Successful cooperative research units require initial and continuing support from three sources: sponsor(s), university administration, and interested faculty members (Friedman & Friedman, 1984). According to Peters and Fusfeld (1983),

The most successful interactions are almost always initiated and nurtured by a key individual who is energetic and has a belief that the success of this program is essential to his professional development. This individual must demonstrate management capabilities as well as excellence in science. Very rarely do programs succeed which are developed conceptually at
the top levels of university administration. There must be enthusiastic faculty support of the program.

(p. 41)

Typically, faculty initiatives are the basis for cooperative arrangements; the continued growth and development requires top-level commitment to cooperative ventures by all sponsors. Committed involvement by higher education administrators and company management is crucial to the success of research interactions because of the flexibility needed to mount such programs and the freedom participants must have from other pressures on time and work (Brodsky, Kaufman, & Tooker, 1979).

Rosenzweig (1982) considers three crucial factors in the development and pursuit of a productive cooperative research program. Foremost is the extent to which the institution and administrators encourage scholarly productivity. Competent faculty and faculty initiative are the other important factors.

Research interactions depend upon organizational characteristics. For industry, one characteristic is the nature of the business. The industries most dependent on research and development and who perform research and development themselves are more likely to fund university research. The major R&D industries are the chemical, pharmaceutical, electronic, computer, fuel, aerospace, automotive, and petroleum fields (Peters & Fusfeld, 1983).
The reasons and methods of interaction with universities of companies within each industrial grouping are based on their specific commercial interests, the product cycle of the industrial sector, and the development stage of the technology (Johnson, 1984). According to Peters and Fusfeld (1983) "the maturity of a scientific concept, the economic climate, and serendipity all play a role in the readiness of an industry to cooperate with university researchers. The time must be right for cooperative commitment to occur" (p 49).

For academic institutions, a characteristic that influences research interactions is the stature of scientific and engineering programs. One method used to measure the stature of a program is the research and development expenditures of the program (Prager & Omenn, 1980). While academic/industrial research ties tend to be concentrated at leading research universities, only about 200 institutions have research expenditures substantial enough to be considered major research universities (Johnson, 1984).

Tornatzky et al. (1982) suggests that the stature of the university must be kept in perspective. They state that in fact, smaller schools frequently have many areas of research excellence quite suitable as Center bases, and may be more open to the structural alternative of a Center than a major institution strongly wedded to traditional grant relationships. What is important is
the willingness of the school to experiment with such an alternative, and to create structures and incentives needed to insure a quality Center. It is not a matter of chance that successful Centers have had strong advocacy and support within the university's central administration, up to and including the university president's office. (p. 11)

They also list other institutional characteristics important to center success including strong research capabilities, an interest in and commitment to work on large-scale programs of importance to industry, and strong leadership in the management of the centers.

In addition to the institutional characteristics outlined above, personal interaction is assumed beneficial to the success of both a cooperative research venture and research productivity. The assertion is made that direct contact and communication between academic and industrial researchers is crucial for productive relationships (Baer, 1977; Johnson, 1984; Sorrows, 1983). In a study of research productivity among scientists in industry, government, and universities, outstanding performance highly correlates with both the level of communication with colleagues and the diversity of work (Pelz & Andrews, 1966).

Only rare instances of university/industry research interaction failure are attributed to disagreements between the two parties concerning patent ownership and distribution
of royalties (Peters & Fusfeld, 1983). At the same time university representatives always mention patent and licensing agreements as a problem encountered when initiating an industry research program. Patent conflicts are listed as one key barrier which prevents given cooperative activities from being developed (Brodsky et al., 1979).

The types of research activities engaged in by centers have been an area of academic discussion but data on directors' attitudes to this issue are not available. The point is made that in dealing with sponsors, cooperative research endeavors must retain basic academic commitments. These commitments include expectations that research findings must be part of the public domain and the linking of research activities to the educational mission of the university (Friedman & Friedman, 1984). Low (1983) states that "university-industry linkages will be successful only if they are based on educational programs of intrinsic academic value" (p. 23). How can universities with interests in research partnerships with industry can best pursue these relationships? Low suggests that universities develop their educational goals and plans, and if these programs happen to interest industry, a basis for developing mutually satisfactory linkages will develop. On the surface, this would appear ideal, from the universities viewpoint.

A renewed interest in university/industry partnerships has emerged given the fact that the lines between pure
research and applied are becoming blurred in a number of fields. Further, the time lag between discovery and commercialization has been shortened considerably. Fundamental research is often able to provide solutions to industry's problems (Johnson, 1984; Low, 1983; Pelz & Andrews, 1966).

The type of research activity is an important factor in the center's success and continued support. Therefore university scientists must relate their research interests to both the missions of the sources of support and the university. According to Peters & Fusfeld (1983), university/industry cooperative research relationships will exist when a program of mutual interest is defined and developed. This idea refutes Low's contentions.

There are fundamental factors necessary for research in any type of organization. Tornatzky et al. (1982) reports that organized research activities are possible only when a collection of people, facilities, and equipment are available. They suggest that the initial development phase of cooperative research units often depends on the reputation of an individual researcher; that successful long-term operations depend upon certain environmental conditions. These conditions include a critical mass of human resources, university faculty, support personnel, and students. Physical resources, or properties in the environment to support and conduct research activities, must be included in this critical mass. Maintaining quality facilities and instrum-
entation is considered an issue for center success and survival. The study by Peters and Fusfeld (1983) finds that the adequacy of university research facilities can serve to stimulate or discourage industry cooperation. Pelz (1956) argues however that resources, both human and physical, are a secondary condition for scientific achievement — the over-riding essential condition is autonomy or self-direction.

Summary

The review of the literature and studies attempts to coordinate two important areas in the work environment: (a) factors that influence the satisfaction of individuals; and (b) factors that influence the performance of the organization. The specific work environment reviewed was university/industry cooperative research centers, the specific individuals were the directors of these centers. The study's purpose was to explore the attitudes of center directors to key elements in their work environment, including variables found to influence satisfaction and variables likely to influence center performance.

As a basis for this study, the review addressed the psychological construct, attitude, and the topic of attitudes in the work environment. The development of this study and the analysis of the results required an understanding of these areas. The review indicated a wealth of information on the topic of job satisfaction but very few
studies focused on the academic profession. A very well-defined area of study and knowledge base was available in the area of high research performance. The challenges that may be encountered for the academic researcher turned research manager were presented. There was a lack of information on the attitudes of directors to management functions. This review also showed that industry/university cooperative research interactions were a growing area of study.

One point that was stressed by those involved in cooperative research endeavors was the important role a center director plays in the development and management of the center. Characteristics and traits important for this research manager have also been presented. While many center activities and views on the role of the center directors were discussed, there was a lack of information about center directors' perception of variables in their work environment. What they think about their work environment and how they feel about their work environment has not been studied. Specifically, the importance attached to and the degree of satisfaction with job dimensions that influence satisfaction and variables that influence the success of centers has not been determined.

The satisfaction of directors has been presented as an important topic for higher education administrators interested in cooperative research endeavors. Center directors are typically faculty members and the assumption might be
made that findings related to job dimensions that influence faculty satisfaction would generalize to this group of academicians. While similarities in the work role exist, since center directors are a subset of the larger set of faculty, differences in the work role may also exist because of the specific responsibilities in this position and inferences may not be totally valid.

Higher education administrators interested in cooperative research endeavors must also be concerned with the success of these activities. The purposes for establishing these centers includes improving ties with industry and fostering industry/university research. High research performance and industry/university interaction are factors likely to influence the successful performance of centers. Therefore, this study also included center directors' attitudes toward factors likely to influence center performance.

A review of the literature suggested that factors necessary for the satisfaction of individuals and factors necessary for the successful performance of the organization were not mutually exclusive areas. For example, recognition, communication and autonomy were listed as satisfying factors and as factors influencing high research performance. The attitude of administrators, which is a part of academic support, was strongly related to research performance, industry/university interactions and job satisfaction.
The influence of other variables, such as the number of articles published, accomplishment of professional goals, and research time, on faculty satisfaction and research performance has been determined.

Data collected from this study should help provide insight into questions such as: (a) Are factors that have been found to influence satisfaction important to center directors? (b) Do center directors believe that factors likely to influence research performance and successful industry/university research interactions are important in their work environment? (c) What is the degree of satisfaction with various key elements?
CHAPTER BIBLIOGRAPHY


CHAPTER III

DATA COLLECTION AND ANALYSES

This chapter presents a description of the methods and procedures used for the collection and analyses of data. Included are descriptions of the target sample, an explanation of the instrument as it relates to the research questions, procedures for the collection of data, and procedures for the analysis of data.

The Target Population

The focus of this study was directors of university-based cooperative research units in engineering or multidisciplinary fields. The title "center director" is the term used by National Science Foundation and "director" is one of the categories of information available from the listings in the Research Centers Directory. The directors in this study are the persons responsible for administering the activities of an organized research unit; they play a major role in planning, organizing, directing, and controlling the operation. Since these organized research units are an integral part of the university environment, directors tend to have teaching, research, or other university-related responsibilities.
In order to explore attitudes of center directors, two groups of cooperative research centers were included to determine if typical attitudes and characteristics exist and to ensure the statistical significance of this study. The target population of this study included directors of cooperative research centers that were similar in that the centers: (a) had a multidisciplinary or engineering focus; (b) were organized as an integral unit of a university; and (c) were supported and funded by industry and other sources. One group of centers that met these three criteria was the NSF Centers Program which sponsors industry-university cooperative research centers (I/UCRCs). This model was often cited in the literature as an example of successful research collaboration between academia and business and was therefore considered an important group to include. Directors of other research centers listed in the 12th edition of the Research Centers Directory that met the three criteria of this study were also included.

Names of the NSF I/UCRC directors were provided by the NSF. Names of directors of other research units meeting the criteria were obtained by reviewing the 12th edition of the Research Centers Directory (1988). This directory lists centers it has recognized and also includes listings submitted by individuals and universities. Based on the criteria established that define the type of centers included in this study, only research units listed in Engineering and
Technology (Section 6) and Multidisciplinary programs (Section 16) were reviewed. The description for each center in these sections was then analyzed. Two specific facts had to be listed for a center to be included in this study: (a) under the heading "Organization Note," the center had to be listed as an integral unit of a university; and (b) under the heading "Sources of Support," industry had to be listed as one of the sources.

The use of the membership list of the NSF I/UCRC program and the selection of centers that met the three criteria listed in the 12th edition of the Research Centers Directory provided a population of 105 individuals.

The survey instrument was mailed to the entire eligible population of 105. The attempt was to receive at least a 60% return of the survey, a percentage considered good for a mailed survey instrument. Centers tend to operate on a yearly basis rather than a semester basis and therefore the timing of the data collection for this study was not considered as a factor that would affect the number of available respondents. A 69% response rate was obtained.

Development of the Survey Instrument

The data required for this study were acquired from a questionnaire and information sheet. The process that produced the final data collecting instruments required an intensive review of the literature in the areas of job satisfaction in academia, determinants of job satisfaction,
correlates of high research performance, characteristics of successful cooperative research endeavors, and issues in research management. This approach was used so that the questionnaire would measure attitudes about a wide variety of key elements in the work environment of center directors. This questionnaire was also designed to gather information about directors' feelings towards various responsibilities and functions believed to be encountered in this position.

Since the main theme of this study was to explore attitudes to key elements in the work environment, only items believed to be relevant or to contribute to job satisfaction and center success were included. It was not the intent of this study to measure all facets of a specific factor or all factors in the work environment of center directors.

To determine if the proposed instrument did indeed address key elements in the work environment of center directors, a panel of five NSF Centers Program evaluators was selected to validate the contents of the questionnaire. The NSF Centers Program requires each I/UCRC to support an evaluator responsible for gathering data about center operations and research outcomes using common instruments. This data collection provides the basis for an overall evaluation of the NSF Centers Program. Each evaluator is free to augment the instrumentation to provide locally relevant evaluation data and assist in other activities as agreed upon by the center and its evaluator. The panel composed of
the following five individuals, listed with their credentials:

Panelist one is a professor in a College of Business and Public Administration and is an evaluator for two centers located at the university.

Panelist two, an independent consultant with a PhD in psychology, has served on various NSF evaluators' committees and has recently been asked to be the evaluator for a developing NSF I/UCRC.

Panelist three is a professor in a School of Management and has been an evaluator for two years.

Panelist four, executive vice president of research development for a non-profit organization, has a PhD in engineering and extensive experience in industry.

Panelist five is a professor in a School of Education and has been a center evaluator for three years.

The panelists were asked to read each statement on the proposed questionnaire and decide if the factor was a relevant work characteristic in the management and development of an organized research unit. Panelists responded by circling the "yes" or "no" response provided after the statement (Appendix A). If the majority (3 out of 5) considered the statement relevant, it was included in the final instrument. If the majority circled "no" the job factor was not included. The panelists were also asked to evaluate the semantics and syntax of the statements; appropriate sug-
gestions were incorporated into the final survey instrument. This procedure resulted in the identification of 53 relevant job aspects (Appendix B).

As part of the survey instrument, information sheets were also designed to collect specific data about the center and its activities. Included were factors that experts in the field consider important factors in the successful operation of organized research units. For centers in the NSF I/UCRC program, a cover sheet requesting the name of the center and a sheet requesting demographic data about the director were stapled to the questionnaire. Information collected and reported in Structural Information for 1986 by Gray, Gidley, and Koester at North Carolina State University in late 1987 provided other center variable information needed for this study as it applied to directors in the NSF industry/university cooperative research centers group.

For the other group of centers directors included in this study, an information sheet was stapled to the questionnaire in order to collect demographic data. A form requesting center structure information was also included with the questionnaire sent to this group. This form was stapled separately since it was possible that this information could have been provided by other personnel involved with the center (Appendix B).
Description of the Survey Instrument

The survey instrument consisted of two parts: data collecting forms and the questionnaire. For centers identified as participants in the NSF I/UCRC program, two information collecting forms were attached to the survey instrument. The first form, Demographic Data, consists of three questions. The respondents were asked to indicate their area of study (science, engineering or other) at both the masters and PhD level. They were also asked to report years of experience (0 years, less than 10 years, 10 - 20 years, and greater than 20 years) in academia, business and/or government. The respondents were also asked to provide the name of the university where they obtained their highest degree. A cover sheet followed requesting the name of the center. Identifying cover sheets were removed after data were entered to ensure confidentiality of respondents, and respondents were informed of this confidentiality procedure. This procedure insured that only information unavailable in the NSF Structural Information for 1986 report was collected and to minimize duplicate respondent information that had recently been supplied.

For non-NSF sponsored cooperative research centers, the information form, Demographic Data, was stapled to the questionnaire. A data collecting form, Center Structure, was stapled separately so that the director or support personnel could provide the required information. Spaces
were provided so that information already available about the NSF sponsored centers could also be collected from this group of organized research units. A total of twelve questions were asked including the name of the center, name of university, research emphasis, number of graduate students, number of researchers, number of current industry members, time allocations, and budget information (Appendix B).

The questionnaire contains two questions requiring respondents to analyze their feelings to 53 job aspects in their work environment. Directors were asked to reflect on: (a) "How important/unimportant I believe this factor is," and (b) "How satisfied/dissatisfied I am with this job aspect." Respondents were asked to rank how important a feature was on a scale of 5 (very important) to 1 (very unimportant). They were then to consider how satisfied they were with this feature on a scale of 5 (very satisfied) to 1 (very dissatisfied). Respondents were instructed to use their position as center director as the point of reference. These two rating scales were used to collect data that were analyzed using the statistical method appropriate to the purpose stated in each research question.

The individual job aspects selected were factors literature and research delineate as being determinants of job satisfaction, correlates of high research performance, factors influencing the success of organized research units, and functions of management. The final questionnaire
measured the importance attached to and satisfaction with job aspects in each of these four categories. Dividing the job aspects into four classifications assisted the initial development and organization of the study. It became apparent that for certain job aspects there was a degree of commonality among these categories. Therefore, a factor analysis using the measure of importance provided a more valid grouping of individual elements. This technique established the statistical correlation between individual aspects and provided an analysis of related factors.

The individual items included in the survey instrument were selected to measure attitudes to factors considered: (a) determinants of job satisfaction; (b) important to high research productivity; (c) issues in research management; and (d) success factors in industry/university cooperation. Chapter 2, Review of the Literature, details each of these areas and provides the rationale for including these factors in the questionnaire. Specific questions relating to each area include the following:

Determinants of Job Satisfaction

Responses to the job dimension of work were measured by questions 2, 8, 17, 29, 30, 41, 43, and 53. Role clarity, a work dimension, was measured by questions 27 and 28. Questions 26 and 42 addressed the individuals' influence regarding decisions in the work environment.
Questions 21 and 35 dealt with the job dimension of recognition. Attitudes to the various dimensions of co-workers were measured by questions 14, 15, and 32, and 45.

Concern for the employee, as well as pay and policies, and company/management job dimensions, were presented in questions 44, 46, 47, 51 and 52.

**High Research Productivity**

Question 1 dealt with research time, and questions 18 and 19 addressed administrative support. These are considered institutionally controlled factors influencing research performance. Questions 5 and 31 addressed interaction with others, a factor controlled largely by the researcher. Reinforcement variables, an important contributor to research performance, were listed 3rd, 4th, and 25th.

Information about the doctoral-degree granting institution of the director (an individually controlled factor), and the university affiliation of the center, (an institutionally controlled factor), were gathered on the information form.

**Issues in the Management of Research Centers**

Reactions to management functions were sought in questions 7, 13, 24, 33, 34, 37, 38, 39, and 40. The information form collected the years of experience in academia, business and/or government since experience in these environments was a requirement, mentioned in the literature, for the position.
Success factors in industry/university research cooperation

Question 10 addressed the issue of patent agreements. Attitudes about communication between various groups, a necessary activity to foster cooperation, was measured by questions 22, 36, 49 and 50. Question 16 dealt with the enthusiasm of faculty, a success factor in center development. To solicit attitudes to the basic factors necessary for research activity, questions 11, 12, 20, 23 and 48 were included that deal with critical mass of people, facilities and equipment. Question 6 and 8 related to the overall research program.

Procedures for Data Collection

As indicated, the study population was directors of cooperative research units in engineering or multidisciplinary fields that are university-based and funded by industry. One hundred five identified individuals fulfilled the population membership criteria discussed in the section, The Target Population. Their names were obtained by using the 1987-8 NSF I/UCRC Program membership list and the 12th edition of the Research Centers Directory (1988). In order to achieve a professional appearance, each individually typed envelope included the name of the director, the university and the organized research unit. This insured that surveys would not be lost due to turnover or incorrect routing. A pre-addressed envelope accompanied each survey. For each group of centers, a personalized cover letter was
sent to the directors, along with the survey instrument indicating the method of selection, the purpose of survey, and the return deadline (Appendix B).

Due to the limited target population size in this study, follow-up mailings were anticipated to generate the required 60 percent return. Surveys requested the respondents to enter the name of their research organization so that the researcher could track respondents and non-respondents. On the day the time-frame for returns expired, respondents were sent a letter of acknowledgment and appreciation. Non-respondents were mailed a second personalized letter and questionnaire with a self-addressed envelope.

For the group of centers not identified by the NSF I/UCRC membership list, non-respondents were also sent a second personalized letter and questionnaire with a self-addressed envelope (Appendix B). Since 60 percent was the stated required return for study validity and because the population is finite, failure to achieve this number would have necessitated repeated attempts to secure responses. Therefore, to promote a quick return, the survey was word processed and commercially printed so that the appearance was professional and attractive. The time frame for return was specified at sixteen days from the date of mailing. This approach encouraged the respondents to make the ques-
tionnaire a priority action item. A 69% response rate was obtained after the second mailing.

Analysis of Data

The stated objectives of this study were to explore attitudes in the work environment of center directors and develop a model of center performance using measured attitudes, center structure data, and center activity data. Thus, the results were subject to limitations: the directors' self-perception and their willingness to provide accurate data. Asking respondents to accurately reflect how they feel about their work and work environment presupposes a high degree of willingness and introspection. The degree of professionalism of this population suggested a high degree of capability, and therefore it was assumed that these respondents have the ability to evaluate their attitudes about work and the environment. It was hoped that the design of the instrument and the promise of strict confidentiality of individual response would offset any inhibition to respond in a truthful manner. Also since questionnaire items may have been perceived differently by individuals, responses were analyzed by groups only.

The data were treated as descriptive information since the focus was on an entire defined population. Data from the information sheet and the NSF sponsored Center Structural Report provided the basis for a detailed comparison of centers in the NSF I/UCRC program and other multidisci-
plinary engineering cooperative research units. Characteristics explored include industrial, teaching, and government experience; average number of graduate students; number of faculty and non-faculty researchers; time devoted to various activities; total operating budget; and other selected factors.

When comparing the time devoted to various activities for each group of center directors, a wide variation was noted. In order to describe this factor, the mean amount of time per activity was calculated. To describe and compare the total operating budgets of centers, the frequency distribution of this data for all centers was calculated. An examination of these data indicated a few outliers—centers either with extremely large or small total operating budgets compared to the rest. Because of this finding, it was decided that the median provided a more accurate description of data.

The name of the university sponsoring the organized research unit was collected. Each university was then assigned the institutional ranking reported in the Early Release of Summary of Statistics on Academic Science/Engineering Resources (1987) by the National Science Foundation University and College Studies Group. This ranking was based on the total 1986 R&D expenditures by the university in science and engineering. Since the employing institution is considered to be a contributing factor to research per-
formance and center success, information describing the ranking of the affiliated universities was obtained. The institutions were then organized into one of the following five categories based on their total R&D expenditures in science and engineering: (a) 0-25, (b) 26-50, (c) 51-75, (d) 75-100, or (e) greater than 100. This same procedure was also used to describe the doctoral degree-granting institution of the center directors.

The information sheet was designed to collect the research emphasis of the centers. In order to categorize the variety of research activities reported, the list was sent to five tenured engineering professors at local universities. Professors were asked to indicate which of seven listed industries would most likely support the reported research focus of the centers. The industries inclined towards research interactions with universities include petroleum, chemicals, automotive, electronics and computer, aerospace, food and pharmaceutical. The industry most likely to support the research activity of the center (as indicated by the majority of the engineering professors) was then used to classify the centers' research emphasis into one of the seven listed categories or a miscellaneous category. A frequency distribution was used to determine the industries most likely to support each group of centers.

The survey instrument measured the degree of importance attached to and satisfaction with key elements in the work
environment of center directors using a five point Likert-response format. To explore and compare the attitudes of the two groups of center directors to individual job aspects, the individual scores for each importance and satisfaction response were recorded. For research questions 1, 2, and 3 the mean importance and satisfaction scores were calculated for each group of center directors. To clarify the relationship between the importance and satisfaction scores reported for each group, the correlation coefficient was then determined.

A factor analysis of individual job aspects based on importance scores provided a reduction in data by grouping variables that were moderately or highly correlated. Each factor consists of items that correlated more highly with each other than other items. The basic key elements in the work environment were then inferred from the content of the items in each factor. This procedure determined the commonalities among the individual job aspects and produced the variables necessary for the statistical analysis of research questions 4, 5, 6, 7, 8, and 9. A conceptual analysis of the job dimensions was also done to verify the groupings. The six key elements determined were (a) academic support, (b) quality of center resources, (c) time and responsibility allocation (d) professional activities, (e) center management activities, and (f) industry/university interactions (Appendix C).
To answer research questions 4 and 5, the t-test for independent groups was used to determine differences in the mean scores for the importance attached to and degree of satisfaction with each key element. To determine the association between importance and satisfaction of key elements for each group of center directors, a correlation coefficient was calculated that provided the information for research question 6.

Performance, or the accomplishments of a center, was defined as the total operating budget (center performance 1) and as the number of industrial members at a center (center performance 2). The rationale for the selection of these two performance measures follows. This was an exploratory study to determine if relationships existed between performance and importance and satisfaction ratings in this environment. The two measures selected were ones that were easily obtainable from the total population of center directors. Also, while there are many other measures of performance, such as the number of publications or the number of students that graduate from these programs, the two selected were considered measures that support the general definition of successful centers and successful research interactions between industry and academia. And finally, studies stress the importance of adequate resources, including monies, to carry out objectives. Studies also state that one reason for the proliferation of cooperative re-
search endeavors is the desire by both parties to improve interactions. Therefore, the number of industrial members at a center is one valid measurement of industry/university interaction.

To determine if importance and satisfaction were predictors of center performance, research questions 7 and 8, required two backward multiple regression analyses. New variables were created for the university ranking for the regression analysis. Universities with a rank of 40 or under, universities ranked 41 to 97, and universities ranked over 97 represented the top, middle, and bottom third based on the university ranking frequency. For center performance defined as the total operating budget divided by the number of faculty and non-faculty researchers, the 18 variables entered into the analyses included: (a) type of center (NSF or non-NSF); (b) the six key element importance scores; (c) the six key element satisfaction scores; (d) university ranking; (e) number of industrial members; (f) percent of time devoted to center administration; (g) percent of time devoted to research and teaching; and (h) percent of time devoted to other administration.

For center performance defined as the number of industrial members divided by the integer obtained by subtracting the year the center was established from 1988, the 20 variables entered into the analyses included: (a) type of center; (b) the six key element importance scores; (c)
the six key element satisfaction scores; (d) university ranking; (e) total budget; (f) number of faculty researchers; (g) number of non-faculty researchers; (h) percent of time devoted to center administration; (i) percent of time devoted to research and teaching; and (j) percent of time devoted to other administration.

To answer research question 9, new variables were created that represented four possible combinations between importance and satisfaction ratings. For the six key elements, the medians of the importance ratings and the satisfaction ratings for the entire group of center directors were calculated and used to classify the scores as high (above median) or low. The combinations considered were:

1. High importance score, high satisfaction score.
2. High importance score, low satisfaction score.
3. Low importance score, high satisfaction score.
4. Low importance score, low satisfaction score (used as the basis for comparison).

This procedure resulted in 18 dummy variables, three combinations of importance/satisfaction ratings for each of the six key elements.

The variables entered into the analysis to measure center performance defined as the total operating budget divided by the number of faculty and non-faculty researchers included the: (a) type of center (NSF/non-NSF); (b) 18 combinations of importance/satisfaction ratings; (c) univer-
sity ranking; (d) industry members; (e) time allocated to center administration; (f) time allocated to research/teaching; and (g) time allocated to other administration.

And finally to measure center performance defined as the number of industrial members divided by the integer obtained by subtracting the year the center was established from 1988, the same variables were analyzed including: (a) type of center; (b) 18 combinations of importance/satisfaction ratings; (d) university ranking; (e) total budget; (f) number of faculty researchers; (g) number of non-faculty researchers; (h) percent of time allocated to center administration; (i) percent of time allocated to research and teaching; and (j) percent of time allocated to other administration.

Delimitation and Limitation of the Study

The study is delimited to academic research structures that pursue industrial support and are committed to engineering or multidisciplinary research. It is subject to the limitations of self-perception or self-evaluation of the respondents. It is further limited by the factors inherent in a questionnaire which is administered by mail, and to the level of honesty of respondents.

Summary

To explore the attitudes of center directors to key elements in their work environment, this study collected empirical data that measured individual perceptions of
importance and satisfaction. In doing so, a descriptive analysis was made about the congruency between "what is desired" and "what is provided" in this environment from the perspective of the center director. An entire identifiable finite population was included as the group of respondents to the survey instrument. A 60 percent minimum return of the population was necessary for statistical analysis and relevant findings.

The study determines the relationship between three areas: (a) influence of center structure variables; (b) center director variables; and (c) attitudes and center performance. The importance attached to key elements, the degree of satisfaction with key elements, and the association between the measures of importance and satisfaction were variables used to develop a predictive model of center performance. Using these and other collected data, predictive models of center performance were developed with performance being defined as: (1) the total operating budget divided by the number of faculty and non-faculty researchers; and (2) the number of industrial members normalized for age of the organized research unit.

In instances where the results of this survey indicate that a conflict exists in the work environment of center directors between what they feel is important and what the environment offers, efforts which can directly influence the emotional state of the respondents should be taken to im-
prove conditions. Where the results indicate that attitude measures and importance/satisfaction association are predictors of performance, further study is needed to establish cause and effect of these relationships.
CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Introduction

The data presented are the results obtained from a survey of professionals responsible for directing and managing cooperative research centers that are (1) university-based, (2) engineering or multidisciplinary in nature, and (3) funded and supported by industry. The survey instrument was designed to measure the importance attached to and degree of satisfaction with key elements in the work environment of center directors. In addition, the descriptive information collected provided the basis for a comparison of various attributes of the two groups of center directors and their centers.

Survey Results

A total of 105 survey instruments were initially mailed to designated center directors. To establish a valid data base, it was decided a 60 per cent return of the population would be required, or a minimum of 63 responses.

For the 38 individuals identified as directors in the National Science Foundation (NSF) Industry/University Center Program, the research plan included a subsequent mailing to
assure the required return. By the designated return date, 24 (63%) of the NSF I/UCRC group had responded. The day following the requested return date, the 14 non-respondents were mailed another personalized letter soliciting their support, a survey instrument, and a self-addressed envelope. The second mailing resulted in 10 returns, for a total of 34 (89%) respondents from the NSF I/UCRC group. Only 33 (87%) of these were useable since one respondent returned the survey instrument unanswered.

In the second target population group, 67 individuals were identified as non-NSF I/UCRC directors of centers that are university-based, committed to engineering or multidisciplinary research, and supported by industry; they were listed in the 12th edition of Research Centers Directory. As was done for group one, the research plan included a subsequent mailing to assure this group's required return. By the designated return date, 36 (53%) of this group had responded. The day following the requested return date, the 31 non-respondents were mailed a second personalized letter soliciting their support, a survey instrument, and a self-addressed envelope. The second mailing resulted in 6 returns, for a total of 42 (63%) respondents from this group. Nine returned responses were unusable. Seven returns indicated that the center had ceased operations and two directors indicated that they had terminated their relationship with industry. As a result, only 33 of the 42 responses
were useable. An examination of the responses from this group indicated that a total of 60 (rather than the original 67) centers were in existence at the time of this study.

Of the revised total population of 96 directors of centers that are university-based, committed to engineering or multidisciplinary research, and supported by industry, the 66 useable responses resulted in a 69% response rate.

Demographic Information

An information form and a survey instrument were sent to the center directors. The form was designed to gather information about the center director and center structure. In order to provide descriptive information about differences and similarities between center directors in the two groups, information about these attributes are organized and presented in Tables 1-7.

Center Directors

Center directors were asked to provide information about the university where they earned their doctorate degree, the university where their center was located, their years of experience in academia, business and/or government, and the amount of time devoted to various activities. Information gathered on these topics is presented under the headings university ranking, various types of work experience, and time allocations.

University Ranking

Information about the research and development (R&D)
expenditures in science and engineering at academic institutions is collected by the National Science Foundation. On the basis of the findings, the top 100 institutions are ranked and the results are prepared by the Universities and Colleges Studies Group (Hoehn, 1987). The doctoral degree granting institution of center directors and the university affiliation of the centers were assigned the rankings from this report. These rankings were then divided into four categories plus a category, >100, was added for universities not ranked in the top 100. In Table 1, the results of the rankings, expressed as percentages, of both university variables are presented.

Table 1
University Ranking Based on R&D Expenditures

<table>
<thead>
<tr>
<th>Group</th>
<th>1-25</th>
<th>26-50</th>
<th>51-75</th>
<th>76-100</th>
<th>&gt;100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PhD granting institution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF(^{(a)})</td>
<td>36</td>
<td>36</td>
<td>3</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>Non-NSF(^{(b)})</td>
<td>38</td>
<td>28</td>
<td>11</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td><strong>Center institution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF(^{(c)})</td>
<td>32</td>
<td>29</td>
<td>0</td>
<td>6</td>
<td>32</td>
</tr>
<tr>
<td>Non-NSF(^{(a)})</td>
<td>3</td>
<td>24</td>
<td>3</td>
<td>36</td>
<td>33</td>
</tr>
</tbody>
</table>
An examination of Table 1 indicates that the majority of directors earned their terminal degree from a university and direct a center at a university where expenditures in science and engineering in R&D are among the top 50 in the country. Seventy-two percent of directors in the NSF group and 66% of the directors in the non-NSF group earned their doctorate from universities ranked in the top 100. The percentage of directors earning their doctorate degree from a university not included in the top 100 list is approximately the same for both groups. The prestige of the doctoral granting institution was listed as a factor likely to influence high research productivity (Merton, 1973).

The results of the rankings of the university affiliation of the centers were similar for the two groups. Sixty-seven percent in the NSF group and 66% in the non-NSF group directed centers at universities ranked in the top 100 for R&D expenditures in science and engineering. The percent of NSF and non-NSF directors directing centers at universities not included in the top 100 list was similar. Employment at a major university that rewards research was listed as a reason faculty become prolific researchers (Creswell, 1985).

Various types of work experience

Directors were asked to provide information about their
academic, industry, and/or government experience using the ranges of 0, <10, 10-20, or >20 years. The purpose of this question was to obtain a general indication about the number of years and the types of work experience of directors. Gray, Hetzner, Eveland, and Gidley (1986) report that to be successful, center directors must be established scientists within the academic community and also be experienced in and respected by the industrial community. Information about the various types and years of experience of NSF and non-NSF center directors, expressed as percentages, is presented in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Years and Types of Work Experiences of Center Directors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>Academic experience</td>
</tr>
<tr>
<td>NSF(a)</td>
</tr>
<tr>
<td>Non-NSF(b)</td>
</tr>
<tr>
<td>Industrial experience</td>
</tr>
<tr>
<td>NSF(a)</td>
</tr>
<tr>
<td>Non-NSF(b)</td>
</tr>
<tr>
<td>Government experience</td>
</tr>
<tr>
<td>NSF(a)</td>
</tr>
<tr>
<td>Non-NSF(c)</td>
</tr>
</tbody>
</table>
Note: Data may not add to totals because of rounding
a\( n = 34 \). b\( n = 33 \). c\( n = 30 \).

An examination of Table 2 indicates that the majority of center directors had ten or more years of academic experience. Approximately one-half of the non-NSF centers were led by directors with over 20 years of experience in academia. Also, the majority of center directors had less than 10 years of experience in business. From comments made by the directors, those describing business experience tended had gained such experience in conjunction with their academic experience, such as consulting work or summer employment. And finally, directors had the least experience in government. Only 23% of NSF directors had worked for the government compared to 46% of non-NSF directors.

Time allocations

The amount of time devoted to research and other activities was mentioned as a possible explanation of high research performance (Pelz, 1956; Finkelstein, 1984) and as a success factor in industry/university cooperative research (Baer, 1977; Johnson, 1984). Center directors were asked to provide an estimate of the percent of time they spend on center administration, research/teaching, and other administration in order to determine the activities requiring the greatest amount of time. The results, expressed in percentage, are presented in Table 3.
Table 3

Time Devoted to Various Job Activities

<table>
<thead>
<tr>
<th>Group</th>
<th>0-25</th>
<th>25-50</th>
<th>50-75</th>
<th>75-100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Center administration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>23</td>
<td>57</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>27</td>
<td>45</td>
<td>25</td>
<td>12</td>
</tr>
</tbody>
</table>

| Research/teaching |      |       |       |        |
| NSF              | 13   | 33    | 37    | 17     |
| Non-NSF          | 21   | 21    | 49    | 9      |

| Other administration |      |       |       |        |
| NSF                 | 77   | 20    | 3     | 0      |
| Non-NSF             | 79   | 15    | 6     | 0      |

Notes. Results are in percentage

*a* N = 30. *b* N = 33.

An examination of Table 3 indicates that the majority of center directors spent less than 50% of their time on center administration but there was also a wide variation in the amount of time devoted to this activity. There was also a wide variation in time spent by the different directors in both groups to research/teaching. The majority of center
directors spent less than 25% of their time on other administration activities. When the average amount of time for each activity was calculated, it was found that both groups devote the greatest amount of time (47%) to research and teaching. Center directors spent the second greatest amount of time (35%) on center administration.

Center Structure

Center directors were also asked to include information about the structure of their center including the total operating budget, research emphasis, number of administrative staff, number of graduate students, number of researchers, and number of industrial members. This information was used to compare center structure attributes between NSF and non-NSF centers.

Total Operating Budget

To understand the structure of these centers, information was collected about the total operating budget, one important resource necessary for successful center operations. The median total operating budget for all centers included in this study was $700,000. This amount was used to categorize the centers in each group as high (above the median) or low (below the median) and the results, expressed in percentage, are presented in Table 4.
Table 4

Classification of Centers Based on Total Operating Budget

<table>
<thead>
<tr>
<th>Category</th>
<th>NSF</th>
<th>Non-NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>50</td>
<td>52</td>
</tr>
<tr>
<td>Low</td>
<td>50</td>
<td>48</td>
</tr>
</tbody>
</table>

An examination of Table 4 indicates that these centers operate under very similar conditions with regards to their total operating budget. There is approximately the same percentage of NSF and non-NSF centers with a total operating budget of less than $700,000 and greater than $700,000.

Critical mass of human resources

Pelz (1956) considers human resources an essential condition for scientific achievement. A critical mass of university faculty, support personnel, and students is also considered a necessary condition for successful industry/university cooperative research by Tornatzky, Hetzner, Eveland, Schwarzkopf, and Colton (1982). Information was collected about the number of professional and administrative support personnel and the number of graduate students associated with the center. The average number in each of these categories is presented in Table 5.
Table 5

**Human Resources Associated with the Center**

<table>
<thead>
<tr>
<th>Resource</th>
<th>NSF</th>
<th>Non-NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty researchers</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Non-faculty researchers</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Graduate students</td>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>Administrative support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Administrative support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

An examination of Table 5 indicates that on average the non-NSF centers employed a larger number of faculty researchers and involved twice as many graduate students. Both groups had the same average number of administrative support personnel and non-faculty researchers.

**Industrial support**

Research interactions between industry and academia depend on various characteristics, including the nature of the industry. The chemical, pharmaceutical, electronic, computer, energy, aerospace, automotive and petroleum fields are the major research and development industries that tend to fund university research (Peters & Fusfeld, 1983).
Science/engineering professors were asked to indicate which of these eight industries would most likely support the center based on its research emphasis. The major R&D industries and the number of centers (expressed in percentage) with a similar research emphasis are presented in Table 6.

Table 6

<table>
<thead>
<tr>
<th>Industry</th>
<th>NSF</th>
<th>Non-NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Chemicals</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>Automotive</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Electronics</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td>Aerospace</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>15</td>
</tr>
</tbody>
</table>

An examination of Table 6 indicates that these centers were likely to be supported by a wide variety of industries. The research emphasis of a small number of centers was too general to categorize and so the category, other, was added. The research emphasis of three non-NSF centers was listed as engineering.
Industrial Members

Centers in this study are supported by industry. Industrial support can include a variety of arrangements such as contract research, funding of a specific project, or membership in a center that requires a fee schedule. Centers were asked to indicate the number of industrial members that support their activity. The analysis of this variable, expressed in percentage, is listed in Table 7.

Table 7
Number of Industrial Members

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>NSF</th>
<th>Non-NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>30</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>10 - 20</td>
<td>43</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>&gt; 20</td>
<td>27</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

An examination of Table 7 indicates that 70% of NSF centers had ten or more industrial sponsors. The majority of non-NSF centers had less than ten industrial members. Eight of the non-NSF centers, while supported by industry, did not indicate any membership agreement with industry.

Research Questions

Using their role as center directors as a point of
reference, respondents were asked to indicate how important a job aspect was to them on a scale of 1 (very unimportant to 5 (very important) and their degree of satisfaction with these job aspects on a scale of 1 (very dissatisfied) to 5 (very satisfied). These data were used to answer research question 1 through research question 9.

Most Important Job Aspects

The purposes of research question 1 were: (a) to determine which of the 53 job aspects from the survey instrument are most important; (b) to explore similarities and differences in responses between the two groups of center directors; and (c) to compare importance and satisfaction measures. Of the 53 job aspects included in this study, 66% have a mean importance of 4.0 or greater. The individual job aspects in common for both groups with a mean importance score of 4.0 (important) or greater compared with the mean satisfaction scores are listed in Table 8.

Table 8

Most Important (IMP) Job Aspects Compared with Satisfaction (SAT) Scores

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>NSF IMP</th>
<th>NSF SAT</th>
<th>Non-NSF IMP</th>
<th>Non-NSF SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research activity-amount (9)</td>
<td>4.73</td>
<td>3.79</td>
<td>4.45</td>
<td>3.58</td>
</tr>
<tr>
<td>Abilities used in job (2)</td>
<td>4.64</td>
<td>3.68(a)</td>
<td>4.67</td>
<td>3.61</td>
</tr>
</tbody>
</table>
Table 8 (continued)

Most Important (IMP) Job Aspects Compared with Satisfaction (SAT) Score

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>NSF</th>
<th>Non-NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IMP SAT</td>
<td>IMP SAT</td>
</tr>
<tr>
<td>Research activity-types (6)</td>
<td>4.61 4.06</td>
<td>4.67 3.91</td>
</tr>
<tr>
<td>Faculty enthusiasm (16)</td>
<td>4.61 3.56</td>
<td>4.72 3.69&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Research equip-quality (11)</td>
<td>4.58 3.62</td>
<td>4.64 3.03</td>
</tr>
<tr>
<td>Competency-students (14)</td>
<td>4.58 3.94</td>
<td>4.66 3.66&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Competency-colleagues (45)</td>
<td>4.55 4.12</td>
<td>4.48 3.97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Student enthusiasm (15)</td>
<td>4.52 4.30</td>
<td>4.44 4.06&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
<tr>
<td>Research equip-quantity (12)</td>
<td>4.52 3.50</td>
<td>4.58 2.97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Quality of lab (20)</td>
<td>4.52 3.82</td>
<td>4.34 3.22</td>
</tr>
<tr>
<td>Money available (48)</td>
<td>4.48 2.76&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.33 3.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Goal accomplishment (8)</td>
<td>4.45 2.85&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.24 2.85&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Research time (1)</td>
<td>4.44 2.82&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.27 3.24&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Decision-making (26)</td>
<td>4.42 3.88</td>
<td>4.27 4.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Professional activities (29)</td>
<td>4.42 3.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.24 3.67</td>
</tr>
<tr>
<td>Professional goals (30)</td>
<td>4.41 2.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.13 3.25</td>
</tr>
<tr>
<td>Influence on planning (42)</td>
<td>4.39 3.94</td>
<td>4.33 3.79&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Knowledge transfer (22)</td>
<td>4.39 3.41</td>
<td>4.18 3.42</td>
</tr>
<tr>
<td>Marketing - new (33)</td>
<td>4.36 2.85&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.16 2.81&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Marketing - retention (34)</td>
<td>4.30 2.85</td>
<td>4.06 3.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>University support (25)</td>
<td>4.30 3.21</td>
<td>4.36 3.12&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Table 8 (continued)

Most Important (IMP) Job Aspects Compared with Satisfaction (SAT) Score

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>NSF IMP</th>
<th>NSF SAT</th>
<th>Non-NSF IMP</th>
<th>Non-NSF SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisory support (35)</td>
<td>4.30</td>
<td>3.74</td>
<td>4.22</td>
<td>3.53</td>
</tr>
<tr>
<td>Admin support-quality (19)</td>
<td>4.24</td>
<td>3.44</td>
<td>4.30</td>
<td>3.39</td>
</tr>
<tr>
<td>University attitude (47)</td>
<td>4.21</td>
<td>3.29</td>
<td>4.24</td>
<td>3.24</td>
</tr>
<tr>
<td>Publications (41)</td>
<td>4.21</td>
<td>3.32*</td>
<td>4.00</td>
<td>3.18</td>
</tr>
<tr>
<td>Faculty interaction (32)</td>
<td>4.21</td>
<td>3.41</td>
<td>4.27</td>
<td>3.36</td>
</tr>
<tr>
<td>Self-esteem (17)</td>
<td>4.15</td>
<td>3.76</td>
<td>4.19</td>
<td>3.91*</td>
</tr>
<tr>
<td>Department interaction (31)</td>
<td>4.15</td>
<td>3.61*</td>
<td>4.27</td>
<td>3.36</td>
</tr>
<tr>
<td>Personnel management (24)</td>
<td>4.12</td>
<td>3.79</td>
<td>4.21</td>
<td>3.88*</td>
</tr>
<tr>
<td>Total compensation (46)</td>
<td>4.12</td>
<td>3.59*</td>
<td>4.06</td>
<td>3.36*</td>
</tr>
<tr>
<td>Professional support (23)</td>
<td>4.06</td>
<td>3.24</td>
<td>4.12</td>
<td>3.24*</td>
</tr>
<tr>
<td>Management issues (7)</td>
<td>4.06</td>
<td>3.56</td>
<td>4.12</td>
<td>3.67</td>
</tr>
<tr>
<td>Responsibilities-clarity (28)</td>
<td>4.06</td>
<td>4.03</td>
<td>4.15</td>
<td>3.73*</td>
</tr>
<tr>
<td>Admin support-number (18)</td>
<td>4.06</td>
<td>3.24</td>
<td>4.27</td>
<td>3.24</td>
</tr>
<tr>
<td>Expectations-clarity (27)</td>
<td>4.03</td>
<td>3.94</td>
<td>4.15</td>
<td>3.76*</td>
</tr>
</tbody>
</table>

Notes. Numbers in parentheses indicate the question number.

* Indicates a negative correlation.

*p < .05.

An examination of Table 8 indicates that center direc-
tors rate job satisfaction, research performance, university-industry cooperative research, and management factors important in their work environment. The importance attached to these job aspects is greater than the directors' degree of satisfaction with these job aspects.

Peters and Fusfeld (1983) suggest that a successful industry/university research relationship will exist when a program of mutual interest is defined and developed. The amount of importance attached to types of research activities (6), amount of research activity (9), and knowledge transfer between organizations (22) indicates the research program is also an important factor for center directors. In addition, the adequacy of research equipment has been found to stimulate or discourage industry cooperation (Pelz & Andrews 1966; Peters & Fusfeld, 1983; Tornatzky et al., 1982). Equipment is an important job aspect for center directors as indicated by the mean importance score given to quality of research equipment (11), amount of research equipment available (12), and quality of lab facilities (20). The enthusiasm of faculty (16) (Peters & Fusfeld, 1983) and a critical mass including support personnel (23) (Tornatzky et al., 1982) are cited as important factors in the success of industry-university research relationships.

Center directors also indicate that being able to perform activities that make use of abilities (2), pursue professional activities (29), and accomplish professional
goals (30) are important factors in their work environment. Locke, Fitzpatrick, and White (1983) list these job aspects as determinants of job satisfaction in both business and academia. Another important item for both groups is the academic competency of center students (14) which is related to the finding that academically competent students are rewarding and satisfying for faculty (Eckert & Stecklein, 1981). The competency of center colleagues (45), the enthusiasm of center students (15), and interaction among faculty (32) were found by Ladd and Lipset (1976) to be determinants of job satisfaction. These factors that characterize co-workers are also important job aspects for center directors. Two important job aspects for directors, clarity of expectations (27) and responsibilities (28), deal with role clarity which has been found to be an important correlate of job satisfaction (Schuler, 1980). In a study by Eckert and Stecklein (1981), freedom and autonomy were found to be determinants of faculty satisfaction. Similar factors included in this study were the freedom to make decisions (26) and influence on planning (42), job aspects that center directors also consider important.

High research performance is influenced by research activities that account for at least 1/3 of an individual's time (Creswell, 1985). Time available for research: (1) is considered an important job aspect for center directors, but directors are not highly satisfied with this job aspect.
Recognition contributes to high research performance (Reskin, 1977). Recognition is considered important to directors as indicated by the high ratings given to university support (25), the attitude of administrators to the center (47), and support from supervisors (35).

In the management of a center, Tornatzky et al., (1983) suggest that directors must be receive adequate logistical support; and they must attend to personnel issues. Directors also consider these factors important as indicated by the high ratings given to the ability to manage personnel (24), money available, (48) and number of administrative support available (18).

In managing a center, the importance of industrial recruitment receive emphasis (Gray et al., 1986; Wilson, 1979). The importance of marketing new members (33) and marketing for retention of current members (34) is also recognized by center directors, but at the same time these aspects are not accorded a high degree satisfaction by center directors.

Directors tend to be somewhat dissatisfied with these important job aspects. Of the 35 more important job aspects, only 11% (NSF group) and 6% (non-NSF group) were accorded a relatively high satisfaction. Also of the 35 more important job aspects, 17% (NSF group) and 2% (non-NSF group) were accorded a relatively low satisfaction. A negative relationship based on a high importance score and a
lower satisfaction score is indicated for 9 (26%) job aspects by the NSF group and 16 (46%) job aspects in the non-NSF group.

A significant negative correlation between importance and satisfaction is indicated for the non-NSF group for the job aspects of student enthusiasm (15), total compensation (46), and university support (25). A significant positive correlation between importance and satisfaction with ability to manage personnel (24) is indicated for this group. For the NSF group, a significant positive correlation between importance and satisfaction with interaction with other departments (31) is indicated.

In exploring responses between the two groups of center directors regarding the most important job aspects, differences exist in the number of important job aspects between groups. The group of NSF I/UCRC directors listed eight other job aspects as important. The additional individual job aspects with a mean importance score of 4.0 (important) or greater compared with the mean satisfaction scores listed by the group of NSF I/UCRC directors are listed in Table 9.
Table 9

Additional Job Aspects Rated Important (IMP) by the NSF Group Compared with Satisfaction (SAT) Scores

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>IMP</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication with IAB (49)</td>
<td>4.45</td>
<td>3.79</td>
</tr>
<tr>
<td>Member company interest (50)</td>
<td>4.44</td>
<td>3.64*</td>
</tr>
<tr>
<td>Interaction w/admin. (5)</td>
<td>4.27</td>
<td>3.26</td>
</tr>
<tr>
<td>Amount of work (53)</td>
<td>4.18</td>
<td>3.18*</td>
</tr>
<tr>
<td>Evaluation-research/teaching (44)</td>
<td>4.12</td>
<td>3.59*</td>
</tr>
<tr>
<td>Recognition from colleagues (4)</td>
<td>4.06</td>
<td>3.35*</td>
</tr>
<tr>
<td>Recognition from university (3)</td>
<td>4.00</td>
<td>3.68**</td>
</tr>
</tbody>
</table>

Notes. Numbers in parentheses indicate the question number.
*Indicates a negative correlation.
*p < .05. **p < .01

An examination of Table 9 indicates that two of these job aspects, 49 and 50, address the issue of membership. The importance placed by the NSF group on industry membership may be attributed to the fact that for NSF I/UCRCs, industrial sponsors must pay a membership fee. The results also indicate a significant positive correlation between the importance and satisfaction with the interest of member
companies. The recognition and interaction job aspects this group considers important were factors that relate to job satisfaction (Porter & Steers, 1973), industry/university research interactions (Tornatzky et al., 1982), and high research performance (Creswell, 1985). There is a significant negative correlation between the importance attached to and the degree of satisfaction with the job aspect, recognition from the university (3). Amount of work (53) and evaluation of research/teaching (44) are important correlates of job satisfaction (Locke et al., 1983). The negative correlations between importance and satisfaction indicates that directors are not highly satisfied with these job aspects they consider important.

**Most Satisfying Job Aspects**

The purposes of research question 2 were: (a) to determine which of the 53 job aspects from the survey instrument are most satisfying; (b) to explore similarities and differences in responses between the two groups of center directors; and (c) to compare satisfaction and importance measures. Of the fifty three job aspects, 4 factors (8%) in the NSF I/UCRC group and 2 factors (4%) in the non-NSF I/UCRC group have a mean satisfaction of 4.0 or greater. The importance attached to individual job aspects with a mean satisfaction score of 4.0 (important) or greater are listed in Table 10.
Table 10

Most Satisfying (SAT) Job Aspects Compared with Importance (IMP) Scores

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>NSF</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enthusiasm of center students (15)</td>
<td>4.30</td>
<td>4.52</td>
<td></td>
</tr>
<tr>
<td>Competency of colleagues (45)</td>
<td>4.12</td>
<td>4.55</td>
<td></td>
</tr>
<tr>
<td>Types of research activities (6)</td>
<td>4.06</td>
<td>4.61</td>
<td></td>
</tr>
<tr>
<td>Understanding of responsibilities (28)</td>
<td>4.03</td>
<td>4.06</td>
<td></td>
</tr>
</tbody>
</table>

Non-NSF

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>Non-NSF</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enthusiasm of students (15)</td>
<td>4.06</td>
<td>4.44*</td>
<td></td>
</tr>
<tr>
<td>Decision-making freedom (26)</td>
<td>4.03</td>
<td>4.27(a)</td>
<td></td>
</tr>
</tbody>
</table>

Notes. Numbers in parentheses indicate the question number.

*Indicates a negative correlation

*p < .05.

An examination of Table 10 indicates that both groups of center directors are most satisfied with the enthusiasm of center students (15). This finding supports previous research (Eckert & Stecklein, 1981) findings that characteristics such as enthusiasm of students are a source of satisfaction for faculty members. This factor is the only
common element between the groups. For both groups, the most satisfying job aspects are also considered important (scores greater than or equal to 4.0).

The group of NSF I/UCRC directors indicate satisfaction with two other factors found to be important correlates of satisfaction -- the competency of co-workers and role clarity (Steers, 1984; Locke et al., 1983). The questionnaire asked if directors thought that an understanding of center responsibilities (role clarity) was important in their work environment. Center directors in this group revealed satisfaction with the type of research activities, also Rosenzweig (1982) reports that the focus of the research program constitutes an important factor in the success of industry/university research relations.

For directors in the non-NSF group, the degree of freedom they had in making center decisions is a satisfactory job factor. This finding supports research by Locke et al. (1983) that freedom in decision making is a determinant of job satisfaction, as well as research findings by Pelz (1956) that autonomy is essential for scientific achievement.

For the NSF group, there are no significant correlations between importance and satisfaction. However, for the non-NSF group, there exists a significant negative correlation between the degree of satisfaction and the importance attached to the enthusiasm of students. In addition,
a negative correlation exists between the importance attached to freedom in making decisions and the degree of satisfaction with this aspect of decision making.

**Least Satisfying Job Aspects**

The purposes of research question 3 were: (a) to determine which of the 53 job aspects are least satisfying; (b) to explore similarities and differences in responses between the two groups of center directors; and (c) to compare satisfaction and importance measures. Of the 53 job aspects, seven factors (13%) in the NSF I/UCRC group and three factors (6%) in the non-NSF I/UCRC group have a mean satisfaction score of 3.0 or less. The importance attached to individual job aspects with a mean satisfaction score of 3.0 (indifferent) or less for each group are listed in Table 11.

**Table 11**

<table>
<thead>
<tr>
<th>Least Satisfying (SAT) Job Aspects Compared with Importance (IMP) Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of money available (48)</td>
<td>2.76</td>
<td>4.48&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Time available for research (1)</td>
<td>2.82</td>
<td>4.44&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Time available to accomplish goals (8)</td>
<td>2.85</td>
<td>4.45&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Table 11 (continued)

**Least Satisfying (SAT) Job Aspects Compared with Importance (IMP) Scores**

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SAT</td>
</tr>
<tr>
<td>Time spent marketing - retention (34)</td>
<td>2.85</td>
</tr>
<tr>
<td>Time spent marketing - new members (33)</td>
<td>2.85</td>
</tr>
<tr>
<td>Time spent on administrative duties (13)</td>
<td>2.90</td>
</tr>
<tr>
<td>Accomplishment of center goals (30)</td>
<td>2.94</td>
</tr>
</tbody>
</table>

Non-NSF

<table>
<thead>
<tr>
<th></th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time spent marketing - new members (33)</td>
<td>2.81</td>
<td>4.16&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Time available to accomplish goals (8)</td>
<td>2.85</td>
<td>4.24&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Research equipment available (12)</td>
<td>2.97</td>
<td>4.58</td>
</tr>
</tbody>
</table>

Notes. Numbers in parentheses indicate the question number. <sup>a</sup>Indicates a negative correlation.

An examination of Table 11 indicates that center directors' degree of satisfaction with time available to accomplish goals (8) and the amount of time spent marketing the center to obtain additional corporate sponsors (33) falls within the dissatisfied (2.0) to indifferent (3.0) range. According to Locke (1976), a factor that influences
the job satisfaction of professionals is the opportunity to accomplish goals. The importance of marketing and the time that must be spent on this activity is discussed as an issue in the success of industry/university research relationships (Gray et al., 1986).

An examination of the results listed for the group of NSF I/UCRC directors, indicates the following significant points:

1. The amount of money available to carry out center activities is the job aspect receiving the lowest measure of satisfaction. According to Pelz and Andrews (1966), Peters and Fusfeld (1983) and Tornatzky et al. (1980), physical resources are part of the critical mass necessary for high research productivity.

2. This group is dissatisfied with the amount of time available to do research. Adequate research time is a factor that influences high research productivity (Creswell, 1985). Research on role clarity in academia describes possible conflicts because of the differing demands for performance in research, teaching and public service (Light, 1974). Libby and Flick (1969) also suggest that researchers must give up the amount of time they spend on the scientific process when they become research managers.

3. Three of the job aspects (13, 33 and 34) measuring dissatisfied/indifferent relate to marketing and administration which can be classified as management responsibilities.
The importance of marketing and its time demands are discussed as important factors in the success of industry/university research relationships (Gray et al., 1986).

An examination of the results listed for the group of non-NSF I/UCRC directors, indicated the area of dissatisfaction, divergent from the major findings among the NSF group:
1. This group is dissatisfied with the amount of research equipment available. This job aspect is an important factor in high research performance (Hinrichs, 1966) as well as for successful industry/university relationships (Peters & Fusfeld, 1983).

An analysis of Table 11 indicates that all but one of the job aspects listed in this table are rated as important (4.0) factors in the work environment. Time spent on administrative duties (13) is rated 3.97, just below the 4.0 needed to be included in the important category. For the majority of these job aspects, there is a negative relationship between the low degree of satisfaction and the high degree of importance attached to these job aspects.

**Between Group Comparison of Importance Ratings**

The purpose of research question 4 was to explore possible difference in the importance attached to the six key elements (determined by the factor analysis) between groups of center directors. A t-test of independent groups was performed on the importance attached to academic support,
competency and quality of center, time and responsibility allocation, professional activities, center management activities and industry/university interactions to determine any statistically significant differences. The results of the analysis are listed in Table 12.

Table 12
Comparison of Importance Scores for Key Elements Between NSF and Non-NSF Group

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
<th>t  value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>33</td>
<td>3.99</td>
<td>.47</td>
<td>-1.46</td>
<td>.150</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>33</td>
<td>4.15</td>
<td>.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of center resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>32</td>
<td>4.43</td>
<td>.36</td>
<td>.63</td>
<td>.529</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>23</td>
<td>4.37</td>
<td>.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time and responsibility allocations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>32</td>
<td>4.11</td>
<td>.37</td>
<td>.89</td>
<td>.375</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>31</td>
<td>4.03</td>
<td>.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>32</td>
<td>4.39</td>
<td>.41</td>
<td>2.33</td>
<td>.023*</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>32</td>
<td>4.14</td>
<td>.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center management activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>32</td>
<td>4.00</td>
<td>.32</td>
<td>.79</td>
<td>.431</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>32</td>
<td>3.94</td>
<td>.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 12 (continued)

**Comparison of Importance Scores for Key Elements Between NSF and Non-NSF Group**

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
<th>t value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF</td>
<td>32</td>
<td>4.29</td>
<td>.45</td>
<td>2.48</td>
<td>.016*</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>29</td>
<td>3.97</td>
<td>.55</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P < .05.

An examination of Table 12 indicates that there is a significant difference in the importance attached to professional activities and industry/university interactions between the two groups of center directors. A review of these scores indicates that these factors are more important in the work environment of the NSF group than the non-NSF group.

A possible explanation for the importance attached to industry/university interactions by directors in the NSF group is that one of the stated objectives of the NSF Centers Program is that centers become self-sustaining within five years. To accomplish this, centers must recruit a sufficient number of industrial members (and industrial membership fees) to cover the loss of NSF funding after the fifth year of operation (Gray et al., 1983). The directors
in the non-NSF group manage structurally diverse centers that are supported by industry in various ways. While it was not the purpose of this study to determine the various industrial support arrangements, one can assume that because of the many types of industrial support and funding procedures available, and because this group does not operate under NSF funding policies, there would be a wide range of importance attached to industry/university interaction by the non-NSF group.

An examination of Table 12 also indicates that both groups of center directors attach the most importance to the key element -- quality of center resources. Professional activities were considered the second most important key element. The non-NSF group attaches more importance to academic support than the NSF group. This is the only instance of a higher importance rating by the non-NSF group.

**Between Group Comparison of Satisfaction Scores**

Research question 5 purports to explore possible difference in the degree of satisfaction with the six key elements determined by the factor analysis between the two groups studied. A t-test of independent groups was performed on the degree of satisfaction with academic support, quality of center resources, time/responsibility allocation, professional activities, center management activities, and industry/university interactions to determine statistically significant differences. The results of the analysis are
listed in Table 13.

Table 13

Comparison of Satisfaction Scores of Key Elements Between NSF and Non-NSF Group

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
<th>t value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>34</td>
<td>3.37</td>
<td>.77</td>
<td>-.12</td>
<td>.903</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>33</td>
<td>3.39</td>
<td>.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of center resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>32</td>
<td>3.66</td>
<td>.38</td>
<td>1.74</td>
<td>.090</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>23</td>
<td>3.49</td>
<td>.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time and responsibility allocations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>33</td>
<td>3.46</td>
<td>.46</td>
<td>-.09</td>
<td>.926</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>31</td>
<td>3.47</td>
<td>.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>32</td>
<td>3.16</td>
<td>.67</td>
<td>-.97</td>
<td>.334</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>32</td>
<td>3.32</td>
<td>.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center management activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>32</td>
<td>3.46</td>
<td>.48</td>
<td>.24</td>
<td>.809</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>33</td>
<td>3.43</td>
<td>.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry/university interactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSF</td>
<td>33</td>
<td>3.22</td>
<td>.68</td>
<td>.02</td>
<td>.982</td>
</tr>
<tr>
<td>Non-NSF</td>
<td>29</td>
<td>3.22</td>
<td>.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
An examination of Table 13 indicates that there are no significant differences in the degree of satisfaction between the NSF group and the non-NSF group. Both groups indicate generally the same discontentment with industry/university interactions, time and responsibility allocation, academic support, and center management activities. Directors are most satisfied with the quality of center resources. However, the NSF group is least satisfied with professional activities while the non-NSF group is least satisfied with industry/university interactions.

**Correlation of Importance and Satisfaction Ratings**

Research question 6 explores the degree of congruency between importance and satisfaction ratings in order to determine if directors are satisfied with the key work environment elements identified as important. The correlation between satisfaction and importance with academic support, quality of center resources, time and responsibility allocation, professional activities, center management activities, and industry/university interactions for both groups is listed in Table 14.
### Table 14

**Importance/Satisfaction Correlations for Key Elements by Group**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Center Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NSF</td>
</tr>
<tr>
<td>Academic Support</td>
<td>-.2231</td>
</tr>
<tr>
<td>Quality of Center Resources</td>
<td>.3410</td>
</tr>
<tr>
<td>Time and Responsibility Allocations</td>
<td>.2327</td>
</tr>
<tr>
<td>Professional Activities</td>
<td>.1436</td>
</tr>
<tr>
<td>Center Management Activities</td>
<td>.3859*</td>
</tr>
<tr>
<td>Industry/University Interactions</td>
<td>.1520</td>
</tr>
</tbody>
</table>

*p < .05.

An examination of Table 14 indicates there is a significant positive relationship between the importance attached to and the degree of satisfaction with center management activities for the group of NSF directors. This element is considered important (4.0) and somewhat satisfying (3.46). In general, a low positive correlation exists between importance and satisfaction ratings with the key elements in the work environment. For instance, there was a negative correlation between importance and satisfaction of
academic support for both groups, indicating that directors tend to be less than highly satisfied with this important element.

Importance/Satisfaction Ratings as Predictors of Performance

The purpose of this analysis is to determine if the importance attached to the six key elements (research question 7) and the degree of satisfaction with the six key elements (research question 8) are predictors of performance. The criterion variable, center performance is defined in two ways. Center performance 1 is defined as the total operating budget divided by the total number of researchers (non-faculty plus faculty). Center performance 2 is defined as the number of industrial members divided by the integer that resulted from subtracting the year the center was established from the current year (1988).

Total Operating Budget

Using total operating budget as the criterion variable, the six important key elements scores and the six satisfaction key elements scores for each center director, plus other collected data, were entered into a backward multiple regression analysis. The amount of variance in the total operating center budget that is predictable from a combination of these variables is $R^2 = .26$, adjusted $R^2 = .20$. Based on the data entered, the variables to be included in predicting the total operating budget of centers are listed
Table 15

Predictive Model of Total Operating Budget Using Importance (IMP) and Satisfaction (SAT) Ratings

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial members</td>
<td>.37</td>
<td>.39</td>
</tr>
<tr>
<td>Industry/university interaction-SAT</td>
<td>.36</td>
<td>.24</td>
</tr>
<tr>
<td>Center management activities-SAT</td>
<td>-.32</td>
<td>-.13</td>
</tr>
</tbody>
</table>

Four significant findings arise from a review of Table 15:

1. In combination with other variables, the importance attached to the six key elements scores are not significant predictors of center performance.

2. Two satisfaction scores are significant predictors of the total operating budget: the degree of satisfaction with both industry/university interactions and center management activities.

3. The degree of satisfaction with center management activities correlates negatively with center performance (r = -.13) and is a negative factor in the predictive model. Directors are not highly satisfied with this job aspect (3.46 by NSF and 3.43 by non-NSF directors). The small variation in scores between groups indicated a consensus of
opinion regarding the degree of satisfaction with this key element. This consensus may account for the significant relationship to performance.

4. The number of industrial members is a significant factor in this predictive model.

**Industrial Membership**

Using industrial membership as the criterion variable, the six important key elements scores and the six satisfaction key elements scores for each center director, plus other collected data, were entered into a backward multiple regression analysis. The amount of variance in center performance that is predictable from a combination of these variables is $R^2 = .57$, adjusted $R^2 = .52$. Based on the data entered, the variables to be included in predicting industrial membership are listed in Table 16.

Table 16

**Predictive Model of Industrial Membership Using Importance (IMP) and Satisfaction (SAT) Ratings**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total operating budget</td>
<td>1.22</td>
<td>.27</td>
</tr>
<tr>
<td>Non-faculty researchers</td>
<td>-.78</td>
<td>.09</td>
</tr>
<tr>
<td>Faculty researchers</td>
<td>-.47</td>
<td>-.15</td>
</tr>
<tr>
<td>NSF I/UCRC</td>
<td>.38</td>
<td>.48*</td>
</tr>
<tr>
<td>University ranking = top 40</td>
<td>.20</td>
<td>.38*</td>
</tr>
</tbody>
</table>
*p < .01.

A review of Table 16 indicates the following:

1. In combination with other variables, the importance attached to the six key elements and the degree of satisfaction with the six key elements are not significant predictors of industrial membership.

2. The analysis results in the following five significant factors predicting center performance 2: (a) number of non-faculty researchers, (b) university rank in top 40, (c) number of faculty researchers, (d) NSF I/UCRC center, and (e) total budget.

3. The correlation coefficients for university ranking and NSF I/UCRCs are statistically significant. Center membership in the NSF Centers Program and centers that are located at a university ranking in the top 40 for R&D expenditures in science and engineering are also significant factors in predicting industrial membership at a center.

4. Defined as the number of industrial members, the number of faculty and non-faculty researchers are negative factors in predicting center performance.

Combinations of Importance and Satisfaction Ratings as Predictors of Performance

The purpose of this analysis was to determine if combinations of the importance attached to and the degree of satisfaction with key elements are predictors of center
performance. The combinations explored included (a) high importance—high satisfaction, (b) high importance—low satisfaction, (c) low importance—high satisfaction, and (d) low importance—low satisfaction. The researcher made several predictions after reviewing the literature on attitudes and job satisfaction in the work environment. There appears to be a strong indication that high importance—high satisfaction has a strong positive relationship with performance. This combination indicates congruency between the center director and their work environment. At the same time, there is strong indication that high importance—low satisfaction has a strong negative relationship with performance. This combination indicates conflict between center directors and their work environment. Since job satisfaction increases productivity, the prediction was made that low importance—high satisfaction would positively relate to performance. The low satisfaction—low importance combination was used as the base.

These combinations were determined for all six key elements and were used to predict total operating budget and industrial membership, the criterion variables. For the population of center directors, the eighteen combination variables plus other collected data were entered into a backward multiple regression analysis.

**Total Operating Budget**

Based on the data entered, the variables to be included
in predicting total operating budget are listed in Table 17. The amount of variance in center performance 1 that is predictable from a combination of these variables is $R^2 = .43$, adjusted $R^2 = .33$.

Table 17

Predictive Model of Total Operating Budget Using Combinations of Importance (IMP) Satisfaction (SAT) Ratings

<table>
<thead>
<tr>
<th>IMP</th>
<th>SAT</th>
<th>Variable</th>
<th>Beta</th>
<th>(r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>+</td>
<td>Time and responsibility allocations</td>
<td>.47</td>
<td>.24</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>Industry/university interactions</td>
<td>-.44</td>
<td>-.12</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>Time and responsibility allocations</td>
<td>.38</td>
<td>.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of industrial members</td>
<td>.34</td>
<td>.38*</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>Professional activities</td>
<td>.32</td>
<td>.17</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>Quality of center resources</td>
<td>-.29</td>
<td>.09</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
<td>Time and responsibility allocations</td>
<td>.27</td>
<td>-.02</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>Quality of center resources</td>
<td>-.25</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Center administration</td>
<td>.22</td>
<td>.26</td>
</tr>
</tbody>
</table>

Notes. + indicates high rating, - indicates low rating

*p < .01.

An examination of Table 17 indicates the following:
1. Seven importance/satisfaction combinations are significant predictors of performance. Four of these combinations support the predictions, including: (a) high importance—high satisfaction with time and responsibility allocations positively relates to center performance; (b) high importance—low satisfaction with quality of center resources negatively relates to performance; (c) high importance—low satisfaction with industry/university interactions negatively relates to center performance; and (d) low importance—high satisfaction with time and responsibility allocations positively relates to performance.

2. Three other significant combinations were predictors of center performance: (a) high satisfaction—high importance with quality of center resources negatively relates to performance; (b) high importance—low satisfaction with professional activities positively relates to performance; and (c) high importance—low satisfaction with time and responsibility allocations positively relates to performance. Combinations (b) and (c) have high importance which indicates that the importance attached to key elements is more significant than the degree of satisfaction in predicting center performance. Further study is needed to understand the negative relationship of high importance—high satisfaction with quality of center resources. Since this key element is a negative predictor of performance in two combinations, the quality of the center resources may nega-
tively relate to performance regardless of the combination of importance and satisfaction ratings.

3. Two other variables, time devoted to center administration and number of industrial members, were included in this predictive model of center performance. The number of industrial members also significantly correlates.

**Industrial Membership**

The combinations between importance and satisfaction for the six key elements and other collected data were entered into a backward multiple regression using industrial membership as the criterion variable. Based on the data entered, the variables to be included in predicting industrial membership are listed in Table 18. The amount of variance in center performance that is predictable from a combination of these variables is $R^2 = .41$, adjusted $R^2 = .35$.

<table>
<thead>
<tr>
<th>Table 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictive Model of Industrial Membership Using Combinations of Importance (IMP) Satisfaction (SAT) Ratings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IMP</th>
<th>SAT</th>
<th>Variable</th>
<th>Beta</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NSF I/UCRC</td>
<td>.50</td>
<td>.40*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total operating budget</td>
<td>.31</td>
<td>.16</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>Quality of center resources</td>
<td>.30</td>
<td>.33*</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
<td>Academic support</td>
<td>.28</td>
<td>.19</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
<td>Time and responsibility allocations</td>
<td>.20</td>
<td>.02</td>
</tr>
</tbody>
</table>
Notes. + indicates high rating, - indicates low rating

*p < .01.

An examination of Table 18 indicates the following:

1. Three importance/satisfaction combinations are significant predictors of performance. One of these associations supports the predictions: low importance--high satisfaction with time and responsibility allocations.

2. Two of the combinations, high importance--low satisfaction with quality of center resources and high importance--low satisfaction with academic support positively relate to performance. Similar findings regarding these combinations are found for center performance 1. In addition, high importance--low satisfaction with quality of center resources was also included in the predictive model of center performance 1, and this factor significantly correlates to center performance 2.

3. Two other variables, membership in the NSF Centers Program (I/UCRC) and total operating budgeting are factors in predicting industrial membership. Membership in the NSF Centers Program also significantly correlates to center performance 2.

Summary

The data presented in this chapter can be summarized as follows:

1. The majority of center directors earned their doctorate degree at an institution ranked in the top 50 for research
and development expenditures in science and engineering.

2. A majority of centers in the NSF I/UCRC program are located at universities ranked in the top 50 for R&D expenditures in science and engineering, while the majority of non-NSF centers are located at universities ranked in the 26-100 range. In both groups, one-third of the centers are located at universities not included in the top 100.

3. The majority of directors in the non-NSF group have over 20 years experience in academia; by comparison, the majority of NSF directors have less than 20 years. On average, both groups' members have less than 10 years of experience in industry, and the majority have no government experience.

4. Wide variations exist in the amount of directors' time devoted to center administration and research/teaching. When calculating the average amount of time per activity, the results are similar in both groups, including the facts that center directors devote forty-seven percent of their time to research/teaching activities and approximately one-third of their time to center administration activities.

5. The median total operating budget of study participants is $700,000. The two groups are similar in that 50% of NSF and non-NSF centers operate at a level above the median and 50% operate at a level below the median.

6. The group of non-NSF directors manage centers that have more faculty researchers and graduate students than the NSF
group. However, both groups direct the same number of non-faculty researchers and administrative support personnel.

7. The majority of NSF centers have 10 or more industrial members while non-NSF centers have less than 10 industrial members. Twenty-four percent of non-NSF centers have no membership agreements with industry whatsoever.

8. Both groups of center directors tend to rate the same job aspects important. Sixty-six percent of the job aspects included in this study are considered important by center directors. However, directors do not tend to be highly satisfied with the job aspects they consider important. Human and physical resource factors are among the most important job aspects, followed by working conditions factors.

9. The group of NSF directors also considers factors related to industrial members and university support important.

10. Very few (8% for NSF directors, 4% for non-NSF directors) of the job aspects receive a rating of satisfied. However, both groups are satisfied with the enthusiasm of students involved in center activities.

11. Both groups of directors are not highly satisfied with the available time to accomplish goals or the amount of time spent marketing to obtain new members; yet these job aspects are considered important by center directors. The NSF group is dissatisfied with seven factors, the non-NSF group with
three factors. There is a negative correlation between importance and satisfaction with the majority of these job aspects.

12. A factor analysis of the importance attached to the 53 job aspects defines the following six key elements: (a) academic support; (b) quality of center resources; (c) time and responsibility allocations; (d) professional activities; (e) center management activities; and (f) industry/university interaction.

13. The importance attached to two key elements produce significant differences between the groups. The NSF directors rate professional activities and industry/university interactions as significantly more important in their work environment than non-NSF directors.

14. No significant differences emerge in the degree of satisfaction with the six key elements between director groups. The highest degree of satisfaction is accorded factors relating to the quality of center resources. Factors relating to professional activities are accorded the lowest satisfaction score by NSF directors, whereas factors relating to industry/university interactions receive the lowest satisfaction score for non-NSF directors.

15. A significant positive correlation exists between the importance attached to and the degree of satisfaction with center management activities for the group of NSF directors. For both groups, there is a negative correlation between
importance and satisfaction with academic support, indicating that directors tend to be somewhat dissatisfied with this important element.

16. In a predictive model of center performance defined as the total operating budget divided by the number of researchers, two satisfaction variables are included. Satisfaction with industry/university interactions is a positive factor, whereas satisfaction with center management activities is a negative factor in the prediction equation. This model accounts for only 26% of the variance in center performance.

17. In the predictive model of center performance defined as the number of industrial members normalized for age of center, importance and satisfaction variables are not included in the equation. Positive factors in the equation include university ranking, membership in the NSF Centers Program, and total operating budget. Negative factors in the equation include the number of faculty and non-faculty researchers. This model accounts for 57% of the variance in center performance and is the best predictive model of center performance established in this study.

18. Four combinations of importance and satisfaction ratings with the six key elements were used as variables in developing predictive models of performance. Three predictions were made: (a) High importance--high satisfaction would have a strong positive relation with center per-
formance, (b) High importance—low satisfaction would have a strong negative relation with center performance, and (c) low importance—high satisfaction would have a positive relation with center performance. The predictive models support a few of these predictions. Other results that do not support these predictions were also factors in the multiple regression equation. Further investigation is suggested in order to understand relationships between the various combinations of importance and satisfaction ratings and center performance.

18. In the predictive model of center performance defined as the total operating budget divided by the number of researchers, seven combinations of importance and satisfaction ratings with key elements were included in the equation. Two other variables, amount of time devoted to center administration and number of industrial members were positive factors in the equation. This model accounts for 43% (adjusted 33%) of the variance in center performance.

19. In predicting the number of industrial members, three combinations of importance and satisfaction ratings with key elements were included in the equation. Two other variables, total operating budget and membership in the NSF Centers Program were positive factors in the equation. This model accounts for 41% (adjusted 35%) of the variance in center performance.


CHAPTER V

SUMMARY, FINDINGS, DISCUSSION, CONCLUSIONS, IMPLICATIONS and
RECOMMENDATIONS FOR FUTURE RESEARCH

Summary

This study explores the importance attached to and the degree of satisfaction with key elements in the work environment of center directors with implications for the development of predictive models of organizational performance. Data for this study were collected from a survey mailed to 105 directors of centers that are (a) university-based, (b) committed to multidisciplinary or engineering research, and (c) supported by industry. This study includes cooperative research centers that operate under policies and procedures established by the National Science Foundation (NSF) and centers that operate under policies and procedures established at the university level. This method permits response comparison from two groups: directors in the National Science Foundation (NSF) Centers Program and directors of other types of cooperative research centers (non-NSF). This comparative method determines if responses from directors in the NSF Industry-University Cooperative Research Center Program (I/UCRC) group are typical and ensures statistically significant results. Using a Likert-
type scale of 1 (low) to 5 (high), 67 respondents (70% usable returns) indicated the importance attached to and degree of satisfaction with 53 job aspects. These data were used to determine: (a) the most important job aspects; (b) the most and least satisfying job aspects; (c) the relationship between the importance and satisfaction ratings of factors in the work environment; and (d) differences in importance and satisfaction ratings between groups of center directors. Predictive models of center performance were developed using collected data that describe the center structure and importance and satisfaction ratings as variables.

In the discussion section, profiles of center directors and center structure are presented followed by a discussion of the findings. The list of findings includes the following:

1. The majority of center directors earned their doctorate degree at an institution ranked in the top 50 for research and development expenditures in science and engineering.

2. A majority of centers in the NSF I/UCRC program are located at universities ranked in the top 50 for R&D expenditures in science and engineering, while the majority of non-NSF centers are located at universities ranked in the 26-100 range. In both groups, one-third of the centers are located at universities not included in the top 100.

3. The majority of directors in the non-NSF group have
over 20 years experience in academia compared to the majority of directors in the NSF group who have less than 20 years of academic experience. Both groups average less than 10 years of experience in industry and the majority have no government experience.

4. There is a wide variation in the amount of time devoted to center administration and research/teaching by center directors. When the average amount of time per activity is calculated, the results are similar in both groups, including the facts that center directors devote the majority of their time (47%) to research/teaching activities and spend approximately one-third of their time on center administration activities.

5. The median total operating budget of study participants is $700,000. The two groups are similar in that 50% of NSF and non-NSF centers operate at a level above the median and 50% operate at a level below the median.

6. The group of non-NSF directors manage centers that have more faculty researchers and graduate students than the NSF group. Both groups direct the same number of non-faculty researchers and administrative support personnel.

7. The majority of NSF centers had 10 or more industrial members while non-NSF centers had less than 10. Twenty-four percent of non-NSF centers had no membership agreements with industry whatsoever.

8. Both groups of center directors tend to rate the same
job aspects important. Sixty-six percent of the job aspects included in this study are considered important by center directors. Directors do not tend to be highly satisfied with the job aspects they considered important. Factors related to human and physical resources are among the most important followed in importance by factors related to working conditions.

9. NSF directors also considered factors related to industrial members and university support important.

10. Very few (8% for NSF directors, 4% for non-NSF directors) of the job aspects are accorded a rating of satisfied. Both groups are satisfied with the enthusiasm of students involved in center activities.

11. Both groups of directors are not highly satisfied with the amount of time available to accomplish goals and the amount of time spent marketing to obtain new members, job aspects that are considered important. The NSF group was dissatisfied with seven factors, the non-NSF group with three factors. There is a negative correlation between importance and satisfaction with the majority of these job aspects.

12. A factor analysis of the importance attached to the 53 job aspects defines the following six key elements: (a) academic support; (b) quality of center resources; (c) time and responsibility allocations; (d) professional activities; (e) center management activities; and (f) industry/univer-
13. There are significant differences in the importance attached to two key elements between the groups. NSF directors rate professional activities and industry/university interactions as significantly more important in their work environment than do the non-NSF directors.

14. There are no significant group differences in the degree of satisfaction with the six key elements. The highest degree of satisfaction is accorded factors related to the quality of center resources. Factors related to professional activities are accorded the lowest satisfaction score by NSF directors. The lowest satisfaction score for non-NSF directors is given to factors related to industry/university interactions.

15. A significant positive correlation exists between the importance attached to and the degree of satisfaction with center management activities for the group of NSF directors. For both groups, there is a negative correlation between importance and satisfaction with academic support indicating that directors tend to be somewhat dissatisfied with this important element.

16. In a predictive model of center performance defined as the total operating budget divided by the number of researchers, two satisfaction variables were included. Satisfaction with industry/university interactions is a positive factor and satisfaction with center management activities is
a negative factor in the prediction equation. This model accounted for only 26% of the variance in center performance.

17. In the predictive model of center performance defined as the number of industrial members normalized for age of center, importance and satisfaction variables were not included in the equation. Positive factors in the equation include university ranking, membership in the NSF Centers Program, and total operating budget. Negative factors in the equation include the number of faculty and non-faculty researchers. This model accounts for 57% of the variance in center performance and is the best predictive model of center performance established in this study.

18. Four combinations of importance and satisfaction ratings with the six key elements were used as variables in developing predictive models of performance. Three predictions were made: (a) high importance—high satisfaction would have a strong positive relation with center performance; (b) high importance—low satisfaction would have a strong negative relation with center performance; and (c) low importance—high satisfaction would have a positive relation with center performance. The predictive models support a few of these predictions. Other results unsupported by these predictions were also factors in the multiple regression equation. Further investigation is suggested in order to understand relationships between the
various combinations of importance and satisfaction ratings and center performance.  

18. In the predictive model of center performance defined as the total operating budget divided by the number of researchers, seven combinations of importance and satisfaction ratings with key elements were included in the equation. Two other variables, amount of time devoted to center administration and number of industrial members were positive factors in the equation. This model accounts for 43% (adjusted 33%) of the variance in center performance.

19. In predicting the number of industrial members, three combinations of importance and satisfaction ratings with key elements were included in the equation. Two other variables, total operating budget and membership in the NSF Centers Program were positive factors in the equation. This model accounts for 41% (adjusted 35%) of the variance in center performance.

Findings

An examination of these findings suggests that center directors consider factors related to successful industry/university cooperation, high research productivity, and job satisfaction important in their work environment. Center directors rate the majority of job aspects explored in this study important.

At centers operating under the influence of policies and procedures established by the NSF, directors accord a
significantly higher degree of importance to factors related to professional activities and industry/university interactions than do directors of centers operating under policies and procedures established at the university level.

This difference in ratings is not evident when comparing the satisfaction scores of the two groups. In general, directors of cooperative research centers accord the same satisfaction ratings to key elements in their work environment. Directors' scores indicate some dissatisfaction with the six key elements under study.

The extremely small number of satisfying job aspects indicated by center directors relate to factors found to influence job satisfaction (Locke, 1976). Directors place a high degree of importance on these satisfying job aspects. The least satisfying job aspects are ones that focus on the amount of time spent on various activities and resources available to the center. At the same time, directors accord a high degree of importance to these least satisfying job aspects. For example, directors are somewhat dissatisfied with the amount of time spent marketing. It is important to note that marketing is a factor that Gray, Hetzner, Eveland, and Gidley (1986) and Tornatzky, Hetzner, Eveland, Schwarzkopf, and Colton (1982) consider essential for successful industry/university research cooperation. Also, directors are less than satisfied with the availability of center resources. Pelz and Andrews (1966) consider research time,
equipment, facilities, and support personnel necessary factors for high research productivity.

Further, directors tend to be somewhat dissatisfied with the important job aspects in their work environment. An examination of the correlation between importance and satisfaction ratings indicates that for the majority of key elements, an imperfect positive correlation exists. For the key element of academic support, an imperfect negative correlation finding indicates that the greater the importance attached to these factors, the greater the degree of dissatisfaction. A significant positive relationship between the importance attached to and the degree of satisfaction with factors related to center management activities is found for directors in the NSF Centers Program. In other words, directors attach the same degree of importance and satisfaction to this key element.

When exploring the implications of importance and satisfaction scores in predicting center performance, an examination of the results indicate that separately these scores are poor indicators in predicting either total operating budget or the number of industrial members at a center. Combinations of importance and satisfaction scores (high importance-low satisfaction, low importance-high satisfaction, high importance-high satisfaction, and low satisfaction-low importance) to certain key elements are found to be factors in predicting both total operating budget and the
number of industrial members at a center. Combining importance and satisfaction scores results in a greater number of these qualitative factors being significant variables in the predictive models than when importance and satisfaction scores are used separately.

Discussion

The profile of center directors evolving from this study includes factors that supports previous research in the areas of: (a) high research productivity; (b) successful industry/university cooperative research; and (c) management of research centers. In describing the profile of a productive researcher, employment at a major university and research activities that account for at least 1/3 of an individual's time are found to enhance the probability of high research productivity (Creswell, 1985). Finkelstein (1984) states that productive researchers were not overly committed to administrative chores. Gray et al. (1986) stress the importance of being an established scientist in academia and having experience in industry as important factors in industry/university cooperative research. The profile of center directors established by this study include these factors.

Based on collected data from the 67 respondents, a center director tends to be an individual who has graduated from a major R&D university, has worked 10 or more years in academia but has less than 10 years experience in
industry and has little or no work experience in government. This individual devotes approximately 47% of his time to research/teaching and 33% to center administration. A director will operate a center that is located at a university whose R&D expenditures in science and engineering are among the top 100 in the nation. This center employs three full-time and two part-time administrative support personnel and six non-faculty researchers. Fifty percent of center directors operate a center with a total operating budget above $700,000.

Industry provides a part of the total center operating budget, therefore it follows that the amount of time spent marketing to obtain industrial support is important to center directors. Other researchers (Gray et al., 1986; Wilson, 1979) stress the importance of marketing to retain current and obtain new industrial support for center activities. At the same time, time spent marketing receives one of the lowest satisfaction ratings of all job aspects (NSF rating 2.85, non-NSF rating 2.81). The empirical evidence demonstrates that while center directors recognize the importance of marketing, they are dissatisfied with the amount of required time spent on this activity.

The many different forms of research ties that can develop between academia and business have been studied (Cromie, 1983; Johnson, 1984; Peters & Fusfeld, 1983). Very few of these studies focus on possible effects of these
different relationships. In comparing the group of NSF
directors and the group of non-NSF directors, evidence
suggests that the industrial membership structure in NSF
I/UCRCs does have an effect. Differences in the amount of
emphasis directors place on industrial membership agreements
between these two groups of centers is reflected in: (a)
the number of industrial members that belong to the centers;
(b) the attitudes of directors to specific individual job
aspects and key elements in their work environment; and (c)
the finding that membership in the NSF Centers Program is a
predictive factor in center performance when performance is
defined as the number of industrial members. Twenty-four
percent of non-NSF centers do not have any membership agree-
ments with industry and the majority of centers have less
than 10 industrial members. All NSF centers have industrial
members and the majority of centers have more than 10 in-
dustrial members.

Also, the significant difference in the importance
attached to industry/university interactions demonstrates a
difference in attitudes between groups of center directors.
The group of NSF center directors rate industry/university
interactions as significantly more important in their work
environment than the group of non-NSF directors. At the
same time, neither group of directors is highly satisfied
with this key element. Both groups rate their degree of
satisfaction with industry/university interactions as 3.22
The importance attached to two job aspects reflects the emphasis on industrial membership by the group of NSF directors. NSF directors rate questions involving communication with the industrial advisory board (IAB) and interest of the member companies in center activities 4.45 and 4.44 respectively (5 = very important). Non-NSF directors rate these job aspects below 4.0 and nine directors failed to respond to the question on communication with IAB.

The best predictive model of center performance (defined as the number of industrial members divided by the number of years the center has been in existence) established by this study includes membership in the NSF Centers program as a positive factor. This finding suggests that the NSF is succeeding in its effort to find ways, such as the NSF Centers Program, to use government funds to facilitate industry/university cooperative research. The NSF provides seed money to I/UCRCs for two purposes: (a) to aid centers in commencing their cooperative research program, and (b) to encourage industry to join the program and provide increasing support. It is understandable that center directors assess industry-university interactions highly. Directors entering this relationship know that the NSF expects companies and the university to completely support center financial operations, since the NSF ceases its funding support after five years (Tornatzky et al., 1982).
According to Peters and Fusfeld (1983) "the identification of the circumstances that encourage the creation and maintenance of strong self-sustaining linkages is the overriding objective of the NSF program. The most critical factor in developing such centers seems to be an energetic leader with a sense of direction" (p. 28). The group of non-NSF directors represent centers that pursue various types of industrial support to establish both short and long term linkages.

The importance attached to factors related to professional activities creates a difference in attitudes between the two groups of center directors. NSF directors assigned professional activities the second highest importance score, whereas the non-NSF directors assigned considerably less importance to this factor. One possible explanation is the directors' career-stage differences. Since the majority of non-NSF directors have over 20 years of experience in academia, compared to less than 20 years for the majority of NSF directors, NSF directors may be at a point in their career where professional goals are still a major priority in their work environment.

This study fills a void in the literature by providing empirical data about what job aspects center directors perceive to be important in their work environment and their degree of satisfaction with these job aspects. This study finds that while differences exist in the importance at-
attached to factors related to industry/university interactions and professional activities between NSF and non-NSF directors, the importance attached to the four other important key elements is similar. Center directors typically attach importance to factors related to academic support, quality of center resources, time and responsibility allocations, and center management activities. This finding suggests that directors accord a high degree of importance to factors involving their personal satisfaction as well as to those that influence the performance of the organization.

The degree of satisfaction accorded the six key elements by NSF directors are typical responses. Overall, center directors are not highly satisfied with the important key elements in their work environment. Only one significant relationship exists between importance and satisfaction. For the group of NSF directors, there is a positive correlation between the amount of importance attached to and the degree of satisfaction with factors related to center management activities. This study indicates that within the center environment conflict exists between what directors consider important and the degree to which that factor is perceived to be present. This finding is similar to the study findings of 332 business faculty members teaching in 15 Canadian universities. According to Hurka (1976), negative correlations between importance and satisfaction measures indicate that the business faculty is
somewhat dissatisfied with the job characteristics they feel are most important. These findings are cause for concern if they are compared to a study by Locke, Fitzpatrick, and White (1983) that finds faculty members are satisfied to the degree they get what is important to them from their work environment. Business faculty members and center directors are not getting what is important to them from their work environment. Locke et al. (1983) also find that the more important the job aspect, the more effect that aspect has on overall job satisfaction. Since 66% of the job aspects in this study are accorded a high degree of importance, it can be concluded that these job aspects will have a large effect on overall job satisfaction.

For both groups of center directors, there is a negative relationship between importance and satisfaction with factors related to academic support. While directors view this element as important in their work environment, they are not highly satisfied with factors such as recognition and interaction with university administration. According to Tornatzky et al. (1982) successful centers have strong advocacy and support within the university's administration. The importance of top-level commitment to cooperative ventures is also stressed by others (Brodsky, Kaufman, & Tooker, 1979; Rosenzweig, 1982). The results of this study indicate that center directors perceive this support to be deficient.
The assumption that attitudes of center directors are predictive factors in center performance is not supported by the results of this study. Factors used in this study accounted for only a very small percentage of the variance in center performance. The predictive models did uncover a few results that warrant further study because they depart from previous research or assumptions about attitudes in the work environment. One of these results is the finding that satisfaction with factors related to center management activities is negatively related to center performance (defined as total operating budget). The literature suggests that satisfaction increases the performance of an individual which, it may be assumed, will in turn increase the performance of the organization. Currently, there is a lack of information regarding the relationship between satisfaction of the key leader and organizational performance. This factor suggests that in the regression equation, the more satisfied directors are with such factors as freedom in decision-making, security of position, number of administrative support individuals, and support from immediate supervisor the greater the participation of this factor in decreasing the predicted total operating budget. In other words, there is a negative relationship between center performance and situations where directors have control and are secure in their position. Another relationship that was brought out in this study is that the number of
faculty and non-faculty researchers is a negative factor in the regression equation for predicting center performance defined as the number of industrial members. Since total operating budget is also a factor in this equation, the relationship between budget/researchers may need to be accounted for in explaining this predictive model. Another factor included in this predictive model is center location at a university with research and development expenditures in the top 40 nationally. This result supports previous findings (Johnson, 1984; Gray et al., 1986) that academic/industrial research ties tend to concentrate at leading research universities.

The predictive models that include the importance/satisfaction associations also only account for a very small percent of the variance in center performance—approximately 33% (adjusted R square) of the variance in center performance. The models did not support the assumptions made that high satisfaction—high importance would have a strong positive relationship to center performance and that high importance—low satisfaction would have a strong negative relationship with performance. While various associations were included as factors in the regression equations, discrepancies in the findings indicate that further study needs to be done in order to understand: (a) importance/satisfaction associations as predictors of center performance; and (b) the relationship between the specific key elements
and their importance/satisfaction associations to center performance.

Conclusions

The following conclusions, which are based on the findings of this study, appear to be warranted when applied to this particular respondent group.

1. Cooperative research centers do not provide, to the extent required, the factors necessary to make this position a satisfying work environment for center directors.

2. Directors of cooperative research centers experience conflict in this role because of discrepancies between what they consider important in their work environment and their degree of satisfaction with these factors.

3. Neither the National Science Foundation (NSF) nor universities have been successful in establishing a work environment for center directors that adequately combines both the interests and needs of the individuals and the interest and needs of the organization.

4. Because of situations that exist in the NSF Centers Program, or the disposition of directors attracted to this work environment, or a combination of these factors, directors of NSF sponsored Industry/University Cooperative Research Centers perceive the importance of industry/university interactions and professional goals differently.

5. University administrators and businesses must consider how center directors perceive their environment in planning
for increased efficiency and effectiveness of industry/university cooperative research relationships and in planning for increased performance and productive output by these organizations.

Implications

The following general implications are based upon the findings and conclusions of this study.

1. Directors of industry/university research centers have similar attitudes regarding their work environment regardless of the structure of the center or the funding arrangement with industry. Since these elements include factors that contribute to the job satisfaction of center directors and the success of the center, higher education administrators should focus on providing these factors to the extent possible and feasible. These important factors should be provided in the work environment of center directors in a satisfying manner. This effort could enhance the commitment and involvement of current center directors and also provide rewarding and satisfying opportunities for other interested researchers.

2. Directors are not highly satisfied with the important key elements in their work environment. Since teaching and research are generally perceived to be intrinsically satisfying careers, the environment in which these activities take place is important. These findings indicate that the personal and professional needs are not being met in centers
are presently constituted. Higher education administrators must take a proactive role to carefully manage the center environment in order to minimize conflict for those individuals interested in directing industry/university cooperative research centers.

3. Higher education administrators are in direct control of the academic support of cooperative research centers. At the same time, directors are not highly satisfied with this factor they consider important in their work environment and which is important to centers' success. Whether this lack of support is due to poor communication or weak commitment by administrators, this is an area that needs attention if industry/university research linkages are deemed important for a university.

4. Directors are dissatisfied with the amount of time spent on marketing to obtain new members. At the same time they attach a high degree of importance to this job aspect. To remedy this conflict, a cooperative effort should be initiated by higher education administrators to devise an efficient and effective marketing plan to assist center directors.

5. A negative correlation is indicated between the importance attached to and the degree of satisfaction with the time available to accomplish goals. Directors are mainly responsible for initiating these centers. If the structure of these centers does not allow time for these goals to be
accomplished, the behavior of the director in this work environment may be affected.

6. Based on results of this study, the attitudes of center directors are not significant factors in center performance. Because those involved in establishing these linkages assign importance to this position, an understanding of the relationship of these attitudes to other types of behavior, such as departure or retention, would expand the knowledge-base regarding the impact of center directors' attitudes on centers and lead to remedial measures.

**Recommendations for Future Research**

Based upon the conclusions of this study, the following recommendations for future research are suggested.

1. A study should be conducted that focuses primarily on the relationship between combinations of importance and satisfaction ratings and center performance. Emphasis should be on both the combinations and the corresponding key element and their relationship to center performance.

2. It is recommended that follow-up studies be conducted that would focus on the retention of the director and the continuance of the center related to the importance and satisfaction scores of center directors obtained in this study. This type of study could determine the relationship between importance and satisfaction scores and subsequent behavior.

3. A study should be conducted that focuses on the job
satisfaction of center directors based on the degree to which important job aspects are available in their work environment. A time study could be done to determine the effect of the actual amount of time devoted to various activities on importance or satisfaction scores or the effect of other quantifiable factors on attitudes.

4. A study should be conducted that determines the effect of importance ratings on the overall job satisfaction of center directors.

5. A study should be conducted that uses other measures of performance, such as the number of articles published by a center or the number of students that graduate, and the variables collected in this study. This study could further the understanding of the role of importance and satisfaction of center directors in predicting center performance.
CHAPTER BIBLIOGRAPHY


March 16, 1988

~F1~
~F2~
~F3~
~F4~

Dear ~F5~:

The purpose of this letter is to ask your assistance in establishing the content validity of a questionnaire to be used as part of a doctoral dissertation at North Texas State University. The study is concerned with the job attitudes of directors of National Science Foundation (NSF) Industry/University Cooperative Research Centers (I/UCRC) and other similar types of organized research units. The purposes of this study are (1) to identify the importance attached to and degree of satisfaction with key elements in the work environment and, and (2) to develop a predictive model of center performance.

Attached is a copy of the research instrument, the Preferred Outcomes Questionnaire. This five-point, Likert-type scale is made up of items to solicit directors' thoughts and feelings toward major areas identified in the literature as pertinent to teaching and research management at three levels in an organization: (1) organization-wide, (2) job content, and (3) job context.

I am seeking your review and judgment to establish content validity of this instrument. Your experience in working with the centers and the directors may confirm that the questionnaire cover the important work characteristics required in the management and development of an industry/university cooperative research center. Your expert opinion is needed in three areas:

1. After reading the question, please indicate the relevance of the questions (circle Y or N). If a majority of the respondents circle Y, the question will be included in the survey.

2. Comments regarding changes in wording or sentence structure would be appreciated. Space has been left between questions for comments/corrections.

3. To obtain maximum validity of this instrument and to accommodate any significant areas that were excluded, suggestions for additional areas/items are welcome.

Thank you in advance for your assistance and cooperation. I would appreciate your returning the evaluation of the Preferred Outcomes Questionnaire to me by March 31, 1988 in the enclosed self-addressed stamped envelope.

Sincerely,

Beverly Kraska
PROPOSED FORMAT

LISTED BELOW, ARE WORK FACTORS OR QUALITIES CONNECT WITH YOUR POSITION AS CENTER DIRECTOR. FOR EACH CHARACTERISTIC, YOU ARE ASKED TO GIVE TWO RATINGS:

1. How important is this characteristic to you?
2. Generally speaking, how satisfied are you with this characteristic?

EACH RATING WILL BE ON A FIVE-POINT SCALE AS INDICATED BELOW:

5 = Very Important 5 = Very Satisfied
4 = Important 4 = Satisfied
3 = Indifferent 3 = Indifferent
2 = Unimportant 2 = Dissatisfied
1 = Very Unimportant 1 = Very Dissatisfied

HOW IMPORTANT IS AND HOW SATISFIED ARE YOU WITH THE FOLLOWING WORK CHARACTERISTICS:

1. The amount of time available to do research.
   (Very Important) 5 4 3 2 1 (Very Unimportant)
   (Very Satisfied) 5 4 3 2 1 (Very Dissatisfied)

RELEVANT?

1. the amount of time available to do research    Y    N
2. the openness, ease and effectiveness of communication between the Center and university administrators.    Y    N
3. the degree to which you are able to negotiate and bargain with R&D administration at your university.    Y    N
4. the amount of influence you have regarding decisions about project selection.    Y    N
5. the degree to which you are able to perform activities that make use of your abilities.    Y    N
6. the amount of recognition you receive from the university for your contributions as center director.    Y    N
7. the amount of recognition you receive from your colleagues for your contributions as center director.    Y    N
8. the interaction between university administration and the Center.    Y    N
9. your ability to resolve Center management issues. Y N
10. the types of research activities being performed at the center. Y N
11. the procedures used by the university for determining salary increases. Y N
12. the amount of research activity being performed at the Center. Y N
13. the patent and licensing agreements of the Center. Y N
14. the quality of research equipment available for Center activities. Y N
15. the quality of laboratory facilities available for Center activities. Y N
16. the degree to which research project results are delivered on time. Y N
17. the amount of time required to perform administrative duties. Y N
18. the enthusiasm of students involved in the Center. Y N
19. the number of administrative support services available to assist in daily Center activities. Y N
20. the contribution your job makes to your feeling of self-esteem. Y N
21. the methods by which knowledge is shared between the Center and industry. Y N
22. the number of professional staff available to support Center activities. Y N
23. your ability to administer and supervise individual research projects. Y N
24. the criteria used to evaluate your accomplishments as Center director. Y N
25. your abilities and experience in managing Center research personnel. Y N
26. the amount of influence you have regarding decisions about budgets and logistics. Y N
27. the amount of encouragement and support given by
the university to the Center. Y N
28. the degree of free you have to make decisions
regarding the Center and its work load. Y N
29. the amount of time available to work with students
on a person-to-person basis when needed. Y N
30. your understanding of what is expected and what
your responsibilities are as director. Y N
31. the opportunity you have to pursue activities you
are interested in. Y N
32. the time available to work with project leaders on
a person-to-person basis when assistance and
guidance is needed. Y N
33. the time available to accomplish goals you have
set for yourself in this role. Y N
34. the amount of interaction between other departments/
disciplines and the Center. Y N
35. the amount of faculty interaction among Center staff. Y N
36. the amount of time spent on marketing the Center to
obtain additional corporate sponsors. Y N
37. the degree to which you participate in the planning
and governance of Center activities. Y N
38. the amount of encouragement and support given by
your immediate supervisor. Y N
39. the opportunity you have to work with college age
students. Y N
40. the responsiveness of the Center to industry needs. Y N
41. the clarity of purpose and the direction of research
projects. Y N
42. the amount of involvement of company project monitors
in research projects. Y N
43. the amount of weight given to teaching in the
evaluation of your work. Y N
44. the degree to which your job is intellectually
stimulating. Y N
45. the degree of freedom to plan your own time schedule and choice of activities.  
46. the number of articles, papers, or books you have been able to publish during your time as Center director.  
47. the amount of influence you have regarding planning and strategy decisions.  
48. the number of meetings you are expected to attend regarding Center activities.  
49. the amount of weight given to research and scholarship in the evaluation of your work.  
50. the competency of the colleagues you work with at the Center.  
51. the competency of the support staff you work with at the Center.  
52. your total annual compensation.  
53. the procedures for selecting new staff members for the Center.  
54. the extent to which promotion criteria are defined and made known by the university.  
55. the enthusiasm of students involved in the Center.  
56. the attitude top administrators have about faculty welfare in terms of working conditions.  
57. the academic competency of students involved in the Center.  
58. the amount of money available to carry out Center's objectives.  
59. the amount of time spent on obtaining funds from member companies.  
60. the quality of communication between the Industrial Advisory Board and the Center.  
61. the amount of participation and involvement by member companies.  
62. the number of policies and procedures that must be met in order to carry out Center activities.
63. the amount of feedback you get on how well you are doing in your role.  
64. the amount of experience and your abilities in marketing the Center.  
65. the amount of security in your job.  
66. your individual performance on your job.  
67. the degree to which you are able to see results of your work.  
68. the amount of work you are either asked to do or responsible to complete within a given period of time.  
69. the degree to which your immediate supervisor takes a personal interest in your work.  
70. the number of job-related aspects which you find personally challenging.  
71. the degree to which your job allows you to complete a wide variety of tasks.  
72. the time spent on Center administrative duties.  
73. the time spent directing Center activities.  
74. the time spent organizing Center activities.  
75. the time spent planning Center activities.  

ADDITIONAL COMMENTS/QUESTIONS:
APPENDIX B

FINAL VERSION OF SURVEY INSTRUMENT AND
COVER LETTERS TO CENTER DIRECTORS
PLEASE WRITE THE NAME OF YOUR CENTER ON THIS SHEET. THIS PROCEDURE WILL PROVIDE CONTROL OVER RETURNS AND PREVENT DUPLICATE MAILINGS OF FOLLOW-UP LETTERS. IT WILL BE REMOVED BEFORE DATA IS ENTERED.

NAME OF CENTER: ____________________________
PREFERRED OUTCOMES QUESTIONNAIRE

LISTED BELOW ARE VARIOUS ASPECTS INHERENT IN DIRECTING INDUSTRY-UNIVERSITY COOPERATIVE RESEARCH CENTERS. FOR EACH FEATURE, YOU ARE ASKED TO GIVE TWO RATINGS:

1. In a work environment, how important is this feature to you?
2. Generally speaking, how satisfied are you with this aspect of your work?

EACH RATING WILL BE ON A FIVE-POINT SCALE AS INDICATED BELOW:

<table>
<thead>
<tr>
<th></th>
<th>Very Important</th>
<th>Important</th>
<th>Indifferent</th>
<th>Unimportant</th>
<th>Very Unimportant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Very Satisfied</th>
<th>Satisfied</th>
<th>Indifferent</th>
<th>Dissatisfied</th>
<th>Very Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

IN YOUR ROLE AS CENTER DIRECTOR:

**HOW IMPORTANT IS THIS FEATURE TO YOU?**

**HOW SATISFIED ARE YOU WITH THIS FEATURE?**

<table>
<thead>
<tr>
<th>Feature Description</th>
<th>Very Important</th>
<th>Important</th>
<th>Indifferent</th>
<th>Unimportant</th>
<th>Very Unimportant</th>
<th>Very Satisfied</th>
<th>Satisfied</th>
<th>Indifferent</th>
<th>Dissatisfied</th>
<th>Very Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amount of time available to do research.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The degree to which you are able to perform activities that make use of your abilities.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The amount of recognition you receive from the university for your contributions as Center Director.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The amount of recognition you receive from your colleagues for your contributions as Center Director.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The amount of interaction between university administration and the Center.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The types of research activities being performed at the Center.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The ease with which you resolve Center management issues.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The time available to accomplish goals you have set for yourself as Center Director.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The amount of research activity being performed at the Center.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Very Important</td>
<td>Indifferent</td>
<td>Unimportant</td>
<td>Very Important</td>
<td>Indifferent</td>
<td>Unimportant</td>
<td></td>
<td></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>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The patent and licensing agreements of the center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The quality of research equipment available for Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The amount of research equipment available for Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The amount of time required to perform administrative duties.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The academic competency of students involved in the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The enthusiasm of students involved in the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The enthusiasm of faculty involved in the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The contribution your job makes to your feelings of self-esteem.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The number of administrative support services available to assist in daily Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The quality of administrative support services available to assist in daily Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The quality of laboratory facilities available for Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The criteria used to evaluate your accomplishments as Center Director.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The methods by which knowledge is shared between the Center and industry.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The number of professional staff available to support Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>Your ability to manage Center personnel.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The amount of encouragement and support given by the university to the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td>The degree of freedom you have to make decisions regarding the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Important</td>
<td>Important</td>
<td>Indifferent</td>
<td>Unimportant</td>
<td>Very Unimportant</td>
<td></td>
<td></td>
<td></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>
<td></td>
</tr>
<tr>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your understanding of what is expected of you as a Center Director.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your understanding of what your responsibilities are as a Center Director.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The opportunity you have to pursue professional activities you are interested in.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The time available to accomplish goals you have set for yourself in this role.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of interaction with other departments/disciplines and the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of interaction among faculty members involved with the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of time spent on marketing the Center to obtain additional corporate sponsors.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of time spent on marketing the Center to retain current members.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of encouragement and support given by your immediate supervisor.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of involvement from company project monitors in research activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of time spent organizing Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of time spent planning Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of time spent directing Center activities.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of time spent managing the Center</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The number of articles, papers, or books you have been able to publish during your time as Center Director.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The amount of influence you have regarding planning decisions that affect the Center.</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The number of meetings you need to attend regarding Center activities:

The amount of weight given to research and scholarship in the evaluation of your work:

The competency of the colleagues you work with:

Your total annual compensation:

The attitude top administrators demonstrate regarding the welfare of faculty:

The amount of money available to carry out Center objectives:

The amount of money available to carry out Center objectives:

The amount of money available to carry out Center objectives:

The clarity of policies and procedures that must be met in order to meet NSF requirements:

The degree of security in your position:

The amount of work you are responsible to complete within a given period of time:

The attitude top administrators demonstrate regarding the welfare of faculty:

The amount of money available to carry out Center objectives:

The amount of money available to carry out Center objectives:

The amount of money available to carry out Center objectives:

The clarity of policies and procedures that must be met in order to meet NSF requirements:

The degree of security in your position:

The amount of work you are responsible to complete within a given period of time:

The number of meetings you need to attend regarding Center activities:

The amount of weight given to research and scholarship in the evaluation of your work:

The competency of the colleagues you work with:

Your total annual compensation:

The attitude top administrators demonstrate regarding the welfare of faculty:

The amount of money available to carry out Center objectives:

The clarity of policies and procedures that must be met in order to meet NSF requirements:

The degree of security in your position:

The amount of work you are responsible to complete within a given period of time:
DEMOGRAPHIC DATA

Please provide the following information:

1. The type of degree you earned at each level:

   MASTERS   Ph.D.
   ___ Science    ___ Science
   ___ Engineering ___ Engineering
   ___ Other      ___ Other

2. What institution did you earn your Ph.D. from?

3. Your work experience (in years) in the following areas:

   ACADEMIA
   ___ 0
   ___ Less than 10 years
   ___ 10 - 20 years
   ___ Greater than 20 years

   BUSINESS/INDUSTRY
   ___ 0
   ___ Less than 10 years
   ___ 10 - 20 years
   ___ Greater than 20 years

   GOVERNMENT
   ___ 0
   ___ Less than 10 years
   ___ 10 - 20 years
   ___ Greater than 20 years
CENTER STRUCTURE

Please answer the following questions as completely as possible:

1. Name of your Center: ____________________________________________
2. Name of University: ____________________________________________
3. Research emphasis of your Center: _________________________________
4. Year Center began operations: _________
5. Number of current industry members: _________
6. Number of full-time administrative staff: _________
7. Number of part-time administrative staff: _________
8. Number of graduate students associated with Center: _________
9. Number of faculty researchers associated with Center: _________
10. Number of non-faculty researchers associated with Center: _________
11. During the past year, what percentage of your time (FTE) was spent on:
    _____ % Center administration
    _____ % Other administration
    _____ % Research
    _____ % Teaching
    _____ % Other
12. Budget information:  (academic year)

**Total Budget Including Overhead:**

1986-1987

**National Science Foundation Funding:**

1986-1987

**Industry Membership Fees:**

1986-1987

**Other Industry Contributions:** (include items such as restricted and
unrestricted cash donations, equipment and supplies, technical
support)

1986-1987

**University Contribution:** (include items such as equipment & supplies,
salaries and returned overhead)

1986-1987

**State Contribution:**

1986-1987

**Other Contributions:** (include grants and awards from public and
private sources, such as D.O.E. grants, private foundation grants)

1986-1987
May 23, 1988

"F1"
"F2"
"F3"
"F4"

Dear "F5":

I am a Ph.D. candidate in Higher Education at the University of North Texas. I have chosen for my dissertation topic the study of the relationship between employee attitudes and organizational performance in a number of key dimensions.

I have been particularly interested in organizations that bring academia and business together in productive ways. David Peterson, an NSF evaluator and a member of my dissertation committee, has identified NSF Industry-University Cooperative Research Centers (I/UCRCs) as fitting this criterion. Various individuals involved with the NSF Centers Program have reviewed my research topic and have indicated a study of the attitudes of Center Directors could be of substantial value. The results of this research could be used to improve the management and structure of I/UCRC.

There are only 38 I/UCRCs operating at this time. In order to obtain results that are of acceptable statistical reliability, it is crucial to obtain responses from all Center Directors. To facilitate your cooperation, I have designed the enclosed "Preferred Outcomes Questionnaire" so that it should take no more than 15 minutes of your time. (I have also enclosed a self-addressed envelope).

In addition to minimizing the time required to fill out the questionnaire, I will be sending to all participants a summary of the results of the study together with a personalized analysis comparing each participant's response with those of the entire group. Strict confidentiality will be maintained at all times. Schools and individual respondents will in no way be identified when results are published.

Your cooperation is vital to the success of my study, and I will be very grateful for your assistance. It will be helpful if you can return the completed questionnaire by June 8th.

Respectfully,

Beverly R. Kraska
June 27, 1988

Dear "F5":

I am a Ph.D. candidate in Higher Education at the University of North Texas. I have been particularly interested in organizations that bring academia and business together in productive ways. I have chosen for my dissertation topic the study of the relationship between the attitudes of center directors and possible influences on center performance. Specifically, these centers must (1) have a research emphasis in science or engineering, (2) be university-based, and (3) have involvement with and support from industry. The results of this research could be used to improve the management and structure of centers.

According to the listing in the 1988 Research Centers Directory, your center is one of a select number that meet these three criteria. In order to obtain results that are of acceptable statistical reliability, it is crucial to obtain a response from your center. To facilitate your cooperation, I have designed the enclosed "Preferred Outcomes Questionnaire" so that it should take no more than 15 minutes of your time. Would you, or a staff member, also provide the requested "Center Structure" information? I have enclosed a self-addressed return envelope for your convenience.

If requested, I will send you a summary of the results of this study. Strict confidentiality will be maintained at all times. Schools and individual respondents will in no way be identified when results are published.

Your cooperation is vital to the success of my study, and I will be very grateful for your assistance. It will be extremely helpful if you can return the completed questionnaire by July 18, 1988.

Respectfully,

Beverly R. Kraska

P.S. If you are not the center director would you please give this to the appropriate person.
Dear "F5":

Would you please take fifteen minutes to complete the enclosed questionnaire? For the last three years, my doctoral studies at the University of North Texas have focused on the relationship between employee attitudes and organizational performance. For my dissertation, I am focusing on the relationship between the attitudes of Center Directors and their influence on center performance.

"F6" Center Directors have completed and returned the enclosed questionnaire. In order to obtain results that are of acceptable statistical reliability, it is crucial to obtain responses from all Center Directors. For your convenience, I have enclosed another questionnaire and self-addressed envelope.

A summary of the results together with a personalized analysis comparing each participant's responses with those of the entire group will be sent to participants who request this information. It will be most helpful if you can return the completed questionnaire by "F7".

Respectfully,

Beverly R. Kraska
APPENDIX C

FACTOR ANALYSIS OF 53 JOB ASPECTS
Academic Support

Amount of recognition from university (03)
Amount of recognition from colleagues (04)
Total annual compensation (46)
Amount of encouragement/support from university (25)
Amount of interaction between administration/center (05)

Quality of Center Resources

Academic competency of students (14)
   Enthusiasm of students (15)
   Enthusiasm of faculty (16)
Competency of center colleagues (45)
Quality of research equipment (11)
Types of research activities being performed (06)
Amount of research equipment (12)
Amount of interaction between center faculty (32)
Quality of laboratory facilities (20)
Attitude of administration to faculty welfare (47)
Perform activities that make use of abilities (02)
Amount of research activity (09)
Contribution of position to self-esteem (17)
Amount of work (53)
Clarity of NSF policies/procedures (51)

Time and Responsibility Allocations

Amount of time spent organizing (37)
Amount of time spent planning (38)
Amount of time spent directing (39)
   Role clarity (28)
   Role expectations (27)
Amount of time spent managing (40)
Amount of interaction with other departments (31)
Influence on planning decisions (42)
Amount of time required to perform admin duties (13)
   Number of meetings (43)

Professional Activities

Number of articles/papers published (41)
Amount of time available for research (01)
Weight given to research/scholarship in evaluation (44)
Opportunity to pursue professional activities (29)
Amount of money available to carry out objectives (48)
Time to accomplish personal goals (30)
Center Management Activities

- Time to accomplish Center goals (08)
- Quality of admin support services (19)
- Personnel management ability (24)
- Interest from member companies (50)
- Ability to resolve management issues (07)
- Number of admin support services (18)
- Encouragement/support from immediate supervisor (35)
- Degree of freedom to make decisions (26)
- Criteria used to evaluate accomplishments (21)
- Degree of security of position (52)
- Number of professional staff (23)
- Patent/licensing agreements (10)

Industry/University Interaction

- Amount of time spent on membership retention (34)
- Amount of time spent marketing to new members (33)
- Involvement of company project monitors (36)
- Knowledge transfer between university/industry (22)
- Communication with Industrial Advisory Board (49)
Table 19

Importance (IMP) Scores Compared with Satisfaction (SAT) Scores for Directors in NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>IMP</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of research activity (09)</td>
<td>4.73</td>
<td>3.79</td>
</tr>
<tr>
<td>Abilities used in job (02)</td>
<td>4.64</td>
<td>3.68</td>
</tr>
<tr>
<td>Types of research activities (06)</td>
<td>4.61</td>
<td>4.06</td>
</tr>
<tr>
<td>Enthusiasm of faculty (16)</td>
<td>4.61</td>
<td>3.56</td>
</tr>
<tr>
<td>Academic competency of students (14)</td>
<td>4.58</td>
<td>3.94</td>
</tr>
<tr>
<td>Quality of research equipment (11)</td>
<td>4.58</td>
<td>3.62</td>
</tr>
<tr>
<td>Competency of center colleagues (45)</td>
<td>4.55</td>
<td>4.12</td>
</tr>
<tr>
<td>Enthusiasm of students (15)</td>
<td>4.52</td>
<td>4.30</td>
</tr>
<tr>
<td>Amount of research equipment (12)</td>
<td>4.52</td>
<td>3.50</td>
</tr>
<tr>
<td>Quality of lab facilities (20)</td>
<td>4.52</td>
<td>3.82</td>
</tr>
<tr>
<td>Center budget (48)</td>
<td>4.48</td>
<td>2.76</td>
</tr>
<tr>
<td>Time to accomplish center goals (08)</td>
<td>4.45</td>
<td>2.85</td>
</tr>
<tr>
<td>Communication w/IAB (49)</td>
<td>4.45</td>
<td>3.79</td>
</tr>
<tr>
<td>Interest of member companies (50)</td>
<td>4.44</td>
<td>3.64</td>
</tr>
<tr>
<td>Time available for research (01)</td>
<td>4.44</td>
<td>2.82</td>
</tr>
<tr>
<td>Time for professional activities (29)</td>
<td>4.42</td>
<td>3.53</td>
</tr>
<tr>
<td>Decision-making freedom (26)</td>
<td>4.42</td>
<td>3.88</td>
</tr>
<tr>
<td>Time to accomplish personal goals (30)</td>
<td>4.41</td>
<td>2.94</td>
</tr>
<tr>
<td>Knowledge transfer w/industry (22)</td>
<td>4.39</td>
<td>3.41</td>
</tr>
<tr>
<td>Influence on planning (42)</td>
<td>4.39</td>
<td>3.94</td>
</tr>
</tbody>
</table>
Table 19 (continued)

Importance (IMP) Scores Compared with Satisfaction (SAT) Scores for Directors in NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>IMP</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing - new members (33)</td>
<td>4.36</td>
<td>2.85</td>
</tr>
<tr>
<td>University support (25)</td>
<td>4.30</td>
<td>3.21</td>
</tr>
<tr>
<td>Marketing - retention (34)</td>
<td>4.30</td>
<td>2.85</td>
</tr>
<tr>
<td>Support from immediate supervisor (35)</td>
<td>4.30</td>
<td>3.74</td>
</tr>
<tr>
<td>Interaction between admin/center (05)</td>
<td>4.27</td>
<td>3.26</td>
</tr>
<tr>
<td>Quality of administrative support (19)</td>
<td>4.24</td>
<td>3.44</td>
</tr>
<tr>
<td>Interaction between center/faculty (32)</td>
<td>4.21</td>
<td>3.41</td>
</tr>
<tr>
<td>Attitudes of administrators to faculty (47)</td>
<td>4.21</td>
<td>3.29</td>
</tr>
<tr>
<td>Number of articles published (41)</td>
<td>4.21</td>
<td>3.32</td>
</tr>
<tr>
<td>Amount of work (53)</td>
<td>4.18</td>
<td>3.18</td>
</tr>
<tr>
<td>Interaction with other departments (31)</td>
<td>4.15</td>
<td>3.61</td>
</tr>
<tr>
<td>Contribution job makes to self-esteem (17)</td>
<td>4.15</td>
<td>3.76</td>
</tr>
<tr>
<td>Ability to manager center personnel (24)</td>
<td>4.12</td>
<td>3.79</td>
</tr>
<tr>
<td>Evaluation of research/scholarship (44)</td>
<td>4.12</td>
<td>3.59</td>
</tr>
<tr>
<td>Total annual compensation (46)</td>
<td>4.12</td>
<td>3.59</td>
</tr>
<tr>
<td>Role clarity (28)</td>
<td>4.06</td>
<td>4.03</td>
</tr>
<tr>
<td>Number of admin. support services (18)</td>
<td>4.06</td>
<td>3.24</td>
</tr>
<tr>
<td>Ability to resolve management issues (07)</td>
<td>4.06</td>
<td>3.56</td>
</tr>
<tr>
<td>Number of professional staff (23)</td>
<td>4.06</td>
<td>3.24</td>
</tr>
<tr>
<td>Recognition from colleagues (04)</td>
<td>4.06</td>
<td>3.35</td>
</tr>
</tbody>
</table>
Table 19 (continued)

Importance (IMP) Scores Compared with Satisfaction (SAT) Scores for Directors in NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>IMP</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role expectations (27)</td>
<td>4.03</td>
<td>3.94</td>
</tr>
<tr>
<td>Recognition from university (03)</td>
<td>4.00</td>
<td>3.68</td>
</tr>
<tr>
<td>Time spent on administrative duties (13)</td>
<td>3.97</td>
<td>2.90</td>
</tr>
<tr>
<td>Evaluation of accomplishments (21)</td>
<td>3.94</td>
<td>3.21</td>
</tr>
<tr>
<td>Amount of time spent directing (39)</td>
<td>3.93</td>
<td>3.38</td>
</tr>
<tr>
<td>Amount of time spent organizing (37)</td>
<td>3.93</td>
<td>3.35</td>
</tr>
<tr>
<td>Amount of time spent planning (38)</td>
<td>3.91</td>
<td>3.35</td>
</tr>
<tr>
<td>Interest of company project monitors (36)</td>
<td>3.88</td>
<td>3.24</td>
</tr>
<tr>
<td>Amount of time spent managing (40)</td>
<td>3.85</td>
<td>3.18</td>
</tr>
<tr>
<td>Number of meetings (43)</td>
<td>3.82</td>
<td>3.09</td>
</tr>
<tr>
<td>Security of position (52)</td>
<td>3.82</td>
<td>3.74</td>
</tr>
<tr>
<td>Clarity of NSF policies (51)</td>
<td>3.59</td>
<td>3.70</td>
</tr>
<tr>
<td>Patent/licensing agreements (10)</td>
<td>3.36</td>
<td>3.38</td>
</tr>
</tbody>
</table>
### Table 20

**Satisfaction (SAT) Scores Compared with Importance (IMP) Scores for Directors in NSF Centers**

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enthusiasm of students (15)</td>
<td>4.30</td>
<td>4.52</td>
</tr>
<tr>
<td>Competency of center colleagues (45)</td>
<td>4.12</td>
<td>4.55</td>
</tr>
<tr>
<td>Types of research activities (06)</td>
<td>4.06</td>
<td>4.61</td>
</tr>
<tr>
<td>Role clarity (28)</td>
<td>4.03</td>
<td>4.06</td>
</tr>
<tr>
<td>Academic competency of students (14)</td>
<td>3.94</td>
<td>4.58</td>
</tr>
<tr>
<td>Role expectation (27)</td>
<td>3.94</td>
<td>4.03</td>
</tr>
<tr>
<td>Influence on planning decisions (42)</td>
<td>3.94</td>
<td>4.39</td>
</tr>
<tr>
<td>Decision-making freedom (26)</td>
<td>3.88</td>
<td>4.42</td>
</tr>
<tr>
<td>Quality of lab facilities (20)</td>
<td>3.82</td>
<td>4.52</td>
</tr>
<tr>
<td>Communication w/IAB (49)</td>
<td>3.79</td>
<td>4.45</td>
</tr>
<tr>
<td>Amount of research activity (09)</td>
<td>3.79</td>
<td>4.73</td>
</tr>
<tr>
<td>Ability to manage center personnel (24)</td>
<td>3.79</td>
<td>4.12</td>
</tr>
<tr>
<td>Contribution job makes to self-esteem (17)</td>
<td>3.76</td>
<td>4.15</td>
</tr>
<tr>
<td>Security of position (52)</td>
<td>3.74</td>
<td>3.82</td>
</tr>
<tr>
<td>Support from immediate supervisor (35)</td>
<td>3.74</td>
<td>4.30</td>
</tr>
<tr>
<td>Clarity of NSF policies (51)</td>
<td>3.70</td>
<td>3.59</td>
</tr>
<tr>
<td>Abilities used in job (02)</td>
<td>3.68</td>
<td>4.64</td>
</tr>
<tr>
<td>Recognition from university (03)</td>
<td>3.68</td>
<td>4.00</td>
</tr>
<tr>
<td>Interest of member companies (50)</td>
<td>3.64</td>
<td>4.44</td>
</tr>
<tr>
<td>Quality of research equipment (11)</td>
<td>3.62</td>
<td>4.58</td>
</tr>
</tbody>
</table>
Table 20 (continued)

Satisfaction (SAT) Scores Compared with Importance (IMP) Scores for Directors in NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction with other departments (31)</td>
<td>3.61</td>
<td>4.15</td>
</tr>
<tr>
<td>Evaluation of research/scholarship (44)</td>
<td>3.59</td>
<td>4.12</td>
</tr>
<tr>
<td>Total annual compensation (46)</td>
<td>3.59</td>
<td>4.12</td>
</tr>
<tr>
<td>Enthusiasm of faculty (16)</td>
<td>3.56</td>
<td>4.61</td>
</tr>
<tr>
<td>Ability to resolve management issues (07)</td>
<td>3.56</td>
<td>4.06</td>
</tr>
<tr>
<td>Time for professional activities (29)</td>
<td>3.53</td>
<td>4.42</td>
</tr>
<tr>
<td>Amount of research equipment (12)</td>
<td>3.50</td>
<td>4.52</td>
</tr>
<tr>
<td>Quality of administrative support (19)</td>
<td>3.44</td>
<td>4.24</td>
</tr>
<tr>
<td>Interaction between center faculty (32)</td>
<td>3.41</td>
<td>4.21</td>
</tr>
<tr>
<td>Knowledge transfer w/industry (22)</td>
<td>3.41</td>
<td>4.39</td>
</tr>
<tr>
<td>Amount of time spent directing (39)</td>
<td>3.38</td>
<td>3.93</td>
</tr>
<tr>
<td>Patent/licensing agreements (10)</td>
<td>3.38</td>
<td>3.36</td>
</tr>
<tr>
<td>Amount of time spent planning (38)</td>
<td>3.35</td>
<td>3.91</td>
</tr>
<tr>
<td>Recognition from colleagues (04)</td>
<td>3.35</td>
<td>4.06</td>
</tr>
<tr>
<td>Amount of time spent organizing (37)</td>
<td>3.35</td>
<td>3.93</td>
</tr>
<tr>
<td>Number of articles published (41)</td>
<td>3.32</td>
<td>4.21</td>
</tr>
<tr>
<td>Attitudes of administrators to faculty (47)</td>
<td>3.29</td>
<td>4.21</td>
</tr>
<tr>
<td>Interaction between admin/center (05)</td>
<td>3.26</td>
<td>4.27</td>
</tr>
<tr>
<td>Number of professional staff (23)</td>
<td>3.24</td>
<td>4.06</td>
</tr>
<tr>
<td>Interest of company project monitors (36)</td>
<td>3.24</td>
<td>3.88</td>
</tr>
</tbody>
</table>
Table 20 (continued)

Satisfaction (SAT) Scores Compared with Importance (IMP) Scores for Directors in NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>Attitude</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of admin support services (18)</td>
<td>3.24</td>
<td>4.06</td>
<td></td>
</tr>
<tr>
<td>Evaluation of accomplishments (21)</td>
<td>3.21</td>
<td>3.94</td>
<td></td>
</tr>
<tr>
<td>Support from university (25)</td>
<td>3.21</td>
<td>4.30</td>
<td></td>
</tr>
<tr>
<td>Amount of work (53)</td>
<td>3.18</td>
<td>4.18</td>
<td></td>
</tr>
<tr>
<td>Amount of time spent managing (40)</td>
<td>3.18</td>
<td>3.85</td>
<td></td>
</tr>
<tr>
<td>Number of meetings (43)</td>
<td>3.09</td>
<td>3.82</td>
<td></td>
</tr>
<tr>
<td>Time spent on administrative duties (13)</td>
<td>2.90</td>
<td>3.97</td>
<td></td>
</tr>
<tr>
<td>Time to accomplish personal goals (30)</td>
<td>2.94</td>
<td>4.41</td>
<td></td>
</tr>
<tr>
<td>Marketing - retention (34)</td>
<td>2.85</td>
<td>4.30</td>
<td></td>
</tr>
<tr>
<td>Time to accomplish center goals (08)</td>
<td>2.85</td>
<td>4.45</td>
<td></td>
</tr>
<tr>
<td>Marketing - new members (33)</td>
<td>2.85</td>
<td>4.36</td>
<td></td>
</tr>
<tr>
<td>Time available for research (01)</td>
<td>2.82</td>
<td>4.44</td>
<td></td>
</tr>
<tr>
<td>Operating budget (48)</td>
<td>2.76</td>
<td>4.48</td>
<td></td>
</tr>
<tr>
<td>Job Aspect</td>
<td>IMP</td>
<td>SAT</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Enthusiasm of faculty (16)</td>
<td>4.72</td>
<td>3.69</td>
<td></td>
</tr>
<tr>
<td>Types of research activities (06)</td>
<td>4.67</td>
<td>3.91</td>
<td></td>
</tr>
<tr>
<td>Abilities used in job (02)</td>
<td>4.67</td>
<td>3.61</td>
<td></td>
</tr>
<tr>
<td>Academic competency of students (14)</td>
<td>4.66</td>
<td>3.66</td>
<td></td>
</tr>
<tr>
<td>Quality of research equipment (11)</td>
<td>4.64</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td>Amount of research equipment (12)</td>
<td>4.58</td>
<td>2.97</td>
<td></td>
</tr>
<tr>
<td>Competency of center colleagues (45)</td>
<td>4.48</td>
<td>3.97</td>
<td></td>
</tr>
<tr>
<td>Amount of research activity (09)</td>
<td>4.45</td>
<td>3.58</td>
<td></td>
</tr>
<tr>
<td>Enthusiasm of students (15)</td>
<td>4.44</td>
<td>4.06</td>
<td></td>
</tr>
<tr>
<td>Support from university (25)</td>
<td>4.36</td>
<td>3.12</td>
<td></td>
</tr>
<tr>
<td>Quality of lab facilities (20)</td>
<td>4.34</td>
<td>3.22</td>
<td></td>
</tr>
<tr>
<td>Influence on planning (42)</td>
<td>4.33</td>
<td>3.79</td>
<td></td>
</tr>
<tr>
<td>Operating budget (48)</td>
<td>4.33</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td>Quality of administrative support (19)</td>
<td>4.30</td>
<td>3.39</td>
<td></td>
</tr>
<tr>
<td>Interaction between admin/center (05)</td>
<td>4.27</td>
<td>3.45</td>
<td></td>
</tr>
<tr>
<td>Interaction between center faculty (32)</td>
<td>4.27</td>
<td>3.36</td>
<td></td>
</tr>
<tr>
<td>Time available for research (01)</td>
<td>4.27</td>
<td>3.24</td>
<td></td>
</tr>
<tr>
<td>Number of admin. support services (18)</td>
<td>4.27</td>
<td>3.24</td>
<td></td>
</tr>
<tr>
<td>Freedom in decision-making (26)</td>
<td>4.27</td>
<td>4.03</td>
<td></td>
</tr>
<tr>
<td>Interaction with other departments (31)</td>
<td>4.27</td>
<td>3.36</td>
<td></td>
</tr>
</tbody>
</table>
Table 21 (continued)

Importance (IMP) Scores Compared with Satisfaction (SAT) Scores for Directors in non-NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>IMP</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional activities (29)</td>
<td>4.24</td>
<td>3.67</td>
</tr>
<tr>
<td>Time to accomplish center goals (30)</td>
<td>4.24</td>
<td>2.85</td>
</tr>
<tr>
<td>Attitudes of administrators to faculty (47)</td>
<td>4.24</td>
<td>3.24</td>
</tr>
<tr>
<td>Support from immediate supervisor (35)</td>
<td>4.22</td>
<td>3.53</td>
</tr>
<tr>
<td>Contribution job makes to self-esteem (17)</td>
<td>4.19</td>
<td>3.91</td>
</tr>
<tr>
<td>Knowledge transfer with industry (22)</td>
<td>4.18</td>
<td>3.42</td>
</tr>
<tr>
<td>Marketing - new members (33)</td>
<td>4.16</td>
<td>2.81</td>
</tr>
<tr>
<td>Role expectation (27)</td>
<td>4.15</td>
<td>3.76</td>
</tr>
<tr>
<td>Role clarity (28)</td>
<td>4.15</td>
<td>3.73</td>
</tr>
<tr>
<td>Time to accomplish personal goals (30)</td>
<td>4.13</td>
<td>3.25</td>
</tr>
<tr>
<td>Number of professional staff (23)</td>
<td>4.12</td>
<td>3.24</td>
</tr>
<tr>
<td>Ability to resolve management issues (07)</td>
<td>4.12</td>
<td>3.67</td>
</tr>
<tr>
<td>Total annual compensation (46)</td>
<td>4.06</td>
<td>3.36</td>
</tr>
<tr>
<td>Marketing - retention (34)</td>
<td>4.06</td>
<td>3.03</td>
</tr>
<tr>
<td>Recognition from colleagues (04)</td>
<td>4.06</td>
<td>3.55</td>
</tr>
<tr>
<td>Number of articles published (41)</td>
<td>4.00</td>
<td>3.18</td>
</tr>
<tr>
<td>Recognition from university (03)</td>
<td>4.00</td>
<td>3.48</td>
</tr>
<tr>
<td>Interest of member companies (50)</td>
<td>3.97</td>
<td>3.22</td>
</tr>
<tr>
<td>Amount of time spent planning (38)</td>
<td>3.91</td>
<td>3.03</td>
</tr>
<tr>
<td>Communication with IAB (49)</td>
<td>3.90</td>
<td>3.41</td>
</tr>
</tbody>
</table>
Table 21 (continued)
Importance (IMP) Scores Compared with Satisfaction (SAT) Scores for Directors in non-NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>IMP</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of accomplishments (21)</td>
<td>3.88</td>
<td>3.39</td>
</tr>
<tr>
<td>Time spent on administrative duties (13)</td>
<td>3.88</td>
<td>3.09</td>
</tr>
<tr>
<td>Amount of time spent directing (39)</td>
<td>3.82</td>
<td>3.42</td>
</tr>
<tr>
<td>Research/scholarship evaluation (44)</td>
<td>3.79</td>
<td>3.42</td>
</tr>
<tr>
<td>Amount of time spent managing (40)</td>
<td>3.79</td>
<td>3.36</td>
</tr>
<tr>
<td>Amount of time spent organizing (37)</td>
<td>3.76</td>
<td>3.21</td>
</tr>
<tr>
<td>Company project monitors (36)</td>
<td>3.66</td>
<td>3.38</td>
</tr>
<tr>
<td>Amount of work (53)</td>
<td>3.59</td>
<td>3.42</td>
</tr>
<tr>
<td>Security of position (52)</td>
<td>3.48</td>
<td>3.85</td>
</tr>
<tr>
<td>Clarity of NSF policies (51)</td>
<td>3.33</td>
<td>3.17</td>
</tr>
<tr>
<td>Number of meetings (43)</td>
<td>3.31</td>
<td>3.30</td>
</tr>
<tr>
<td>Patent/licensing agreements (10)</td>
<td>3.27</td>
<td>3.52</td>
</tr>
</tbody>
</table>
Table 22
Satisfaction (SAT) Scores Compared with Importance (IMP) Scores for Directors in non-NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enthusiasm of students (15)</td>
<td>4.06</td>
<td>4.44</td>
</tr>
<tr>
<td>Decision-making freedom (26)</td>
<td>4.03</td>
<td>4.27</td>
</tr>
<tr>
<td>Competency of center colleagues (45)</td>
<td>3.97</td>
<td>4.48</td>
</tr>
<tr>
<td>Contribution job makes to self-esteem (17)</td>
<td>3.91</td>
<td>4.19</td>
</tr>
<tr>
<td>Types of research activities (06)</td>
<td>3.91</td>
<td>4.67</td>
</tr>
<tr>
<td>Ability to manage center personnel (24)</td>
<td>3.88</td>
<td>4.21</td>
</tr>
<tr>
<td>Security of position (52)</td>
<td>3.85</td>
<td>3.48</td>
</tr>
<tr>
<td>Influence on planning decisions (42)</td>
<td>3.79</td>
<td>4.33</td>
</tr>
<tr>
<td>Role expectation (27)</td>
<td>3.76</td>
<td>4.15</td>
</tr>
<tr>
<td>Role clarity (28)</td>
<td>3.73</td>
<td>4.15</td>
</tr>
<tr>
<td>Enthusiasm of faculty (16)</td>
<td>3.69</td>
<td>4.72</td>
</tr>
<tr>
<td>Ability to resolve management issues (07)</td>
<td>3.67</td>
<td>4.12</td>
</tr>
<tr>
<td>Professional activities (29)</td>
<td>3.67</td>
<td>4.24</td>
</tr>
<tr>
<td>Academic competency of students (14)</td>
<td>3.66</td>
<td>4.66</td>
</tr>
<tr>
<td>Activities use abilities (02)</td>
<td>3.61</td>
<td>4.67</td>
</tr>
<tr>
<td>Amount of research activity (09)</td>
<td>3.58</td>
<td>4.45</td>
</tr>
<tr>
<td>Recognition from colleagues (04)</td>
<td>3.55</td>
<td>4.06</td>
</tr>
<tr>
<td>Support from immediate supervisor (35)</td>
<td>3.53</td>
<td>4.22</td>
</tr>
<tr>
<td>Patent/licensing agreements (10)</td>
<td>3.52</td>
<td>3.27</td>
</tr>
<tr>
<td>Recognition from university (03)</td>
<td>3.48</td>
<td>4.00</td>
</tr>
</tbody>
</table>
Table 22 (continued)

Satisfaction (SAT) Scores Compared with Importance (IMP) Scores for Directors in non-NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction between admin/center (05)</td>
<td>3.45</td>
<td>4.27</td>
</tr>
<tr>
<td>Knowledge transfer w/industry (22)</td>
<td>3.42</td>
<td>4.18</td>
</tr>
<tr>
<td>Amount of work (53)</td>
<td>3.42</td>
<td>3.59</td>
</tr>
<tr>
<td>Amount of time spent directing (39)</td>
<td>3.42</td>
<td>3.82</td>
</tr>
<tr>
<td>Research/scholarship evaluation (44)</td>
<td>3.42</td>
<td>3.79</td>
</tr>
<tr>
<td>Communication with IAB (49)</td>
<td>3.41</td>
<td>3.90</td>
</tr>
<tr>
<td>Quality of administrative support (19)</td>
<td>3.39</td>
<td>4.30</td>
</tr>
<tr>
<td>Evaluation of accomplishments (21)</td>
<td>3.39</td>
<td>3.88</td>
</tr>
<tr>
<td>Company project monitors (36)</td>
<td>3.38</td>
<td>3.66</td>
</tr>
<tr>
<td>Total annual compensation (46)</td>
<td>3.36</td>
<td>4.06</td>
</tr>
<tr>
<td>Amount of time spent managing (40)</td>
<td>3.36</td>
<td>3.79</td>
</tr>
<tr>
<td>Interaction with other departments (31)</td>
<td>3.36</td>
<td>4.27</td>
</tr>
<tr>
<td>Interaction between center faculty (32)</td>
<td>3.36</td>
<td>4.27</td>
</tr>
<tr>
<td>Number of meetings (43)</td>
<td>3.31</td>
<td>3.30</td>
</tr>
<tr>
<td>Time to accomplish personal goals (30)</td>
<td>3.25</td>
<td>4.31</td>
</tr>
<tr>
<td>Attitude of admin to faculty (47)</td>
<td>3.24</td>
<td>3.24</td>
</tr>
<tr>
<td>Number of admin support services (18)</td>
<td>3.24</td>
<td>4.27</td>
</tr>
<tr>
<td>Time available for research (01)</td>
<td>3.24</td>
<td>4.27</td>
</tr>
<tr>
<td>Number of professional staff (23)</td>
<td>3.24</td>
<td>4.12</td>
</tr>
<tr>
<td>Quality of lab facilities (20)</td>
<td>3.22</td>
<td>4.34</td>
</tr>
</tbody>
</table>
Table 22 (continued)

Satisfaction (SAT) Scores Compared with Importance (IMP) Scores for Directors in non-NSF Centers

<table>
<thead>
<tr>
<th>Job Aspect</th>
<th>SAT</th>
<th>IMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest of member companies (50)</td>
<td>3.22</td>
<td>3.97</td>
</tr>
<tr>
<td>Amount of time spent organizing (37)</td>
<td>3.21</td>
<td>3.76</td>
</tr>
<tr>
<td>Number of articles published (41)</td>
<td>3.18</td>
<td>4.00</td>
</tr>
<tr>
<td>Clarity of NSF policies (51)</td>
<td>3.17</td>
<td>3.33</td>
</tr>
<tr>
<td>Support from university (25)</td>
<td>3.12</td>
<td>4.36</td>
</tr>
<tr>
<td>Time spent on administrative duties (13)</td>
<td>3.09</td>
<td>3.88</td>
</tr>
<tr>
<td>Total operating budget (48)</td>
<td>3.03</td>
<td>4.33</td>
</tr>
<tr>
<td>Marketing - retention (34)</td>
<td>3.03</td>
<td>4.06</td>
</tr>
<tr>
<td>Quality of research equipment (11)</td>
<td>3.03</td>
<td>4.64</td>
</tr>
<tr>
<td>Amount of time spent planning (38)</td>
<td>3.03</td>
<td>3.91</td>
</tr>
<tr>
<td>Amount of research equipment (12)</td>
<td>2.97</td>
<td>4.58</td>
</tr>
<tr>
<td>Time to accomplish center goals (08)</td>
<td>2.85</td>
<td>4.24</td>
</tr>
<tr>
<td>Marketing - new members (33)</td>
<td>2.81</td>
<td>4.16</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY

Attitudes in the Work Environment


**Determinants of Job Satisfaction**


High Research Performance


Research and Research Center Management


Whyte (Eds.), *Administering research and development* (pp. 380-387). New York: Dorsey Press.


Industry/University Cooperative Research


