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University/Industry Cooperative Research Centers:

An Examination of Two Factors that Influence Sponsor Satisfaction

by

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ABSTRACT

This study views the University/Industry Cooperative Research Centers set up by the National Science Foundation to encourage closer cooperation between academic and industrial researchers. Specifically, the study aims to examine corporate sponsor satisfaction and two factors which may affect satisfaction, namely, participation and outcomes.

Corporate sponsor representatives have provided the data which have been used in this study. As a part of an ongoing NSF evaluation, representatives are asked to complete an NSF questionnaire each year for the first five years of a center's existence. Dr. Denis Gray of North Carolina State University provided such data collected from eight of the UICR centers in 1983. Also included in this data sample were data collected in 1986 from the two centers at Lehigh University.

The objectives of the study are twofold. The first objective is to construct scales using these data which will serve as indices of participation, outcomes and satisfaction, and test these scales for their robustness. The second objective is to examine the relationships among these variables.

Scales have been constructed which meet the three minimum requirements of a scale, reproducibility, reliability, and unidimensionality.

Analysis of the results shows that when the entire group of respondents, N=99, is considered, the only relationship that is supported is the association of greater research outcomes with higher satisfaction.

For the subgroup of respondents, N=41, who have noted at least some results in product and process outcomes, however, several hypothesized relationships are supported. Higher satisfaction is associated with greater research outcomes, as it was with the entire group. Another relationship which is supported is that greater satisfaction is also associated with greater outcomes in products and processes. Finally, a relationship is also noted between greater company participation and higher satisfaction.

CHAPTER 1
INTRODUCTION

In the early part of the 1970's, the Federal government recognized a need to encourage closer cooperation between academic and industrial researchers. To respond to this need, the National Science Foundation (NSF) developed the University/Industry Cooperative Research Center program and now sponsors a number of UICR Centers.

These centers were designed to link the research needs of industry with university scientists to facilitate the dissemination of the technical advances which result from academic research. The centers support research in a particular area of science, and the administrative core acts as a liaison between university faculty doing research in this area and industries which would be interested in these research results.

The National Science Foundation provides partial funding for these centers for the first five years of operation. They also rely on funds provided by industrial sponsors in the form of yearly membership fees. The desired outcome is for the centers to continue operating with funding from industry after the National Science Foundation funds have been terminated.

In order to monitor the progress of the centers, NSF has provided for a systematic assessment of all centers. Besides merely evaluating the individual centers, this assessment is also intended to provide valuable feedback to NSF about the attributes of centers which have been successful in fulfilling the objectives of the program. Because there were several objectives intended for these centers, success may be defined in different ways.

To the university, a center may be seen as fulfilling its objectives if it is able to conduct research projects which are supported with funding from industrial rather than university or governmental sources. Another university objective may be to have the center faculty incorporate into their teaching curriculum, the knowledge gained from industry about the latest applications of research in the field. This helps to keep faculty and students in touch with industrial problems and possible solutions.

Industry may view fulfillment of center objectives somewhat differently. Success may be judged by the utility of the research and educational opportunities produced by the center. The research may be used to improve products or processes within the company, or simply to spawn new ideas for research or new methods to evaluate present research. Still other industries may be concerned with whether or not a center provides a supply of well-trained personnel who have a working knowledge of the needs of industry in a particular field.

Because the ultimate objective of the National Science Foundation is to encourage closer cooperation between academic and industrial researchers, the Federal government would hope that the centers continue to operate with funds from industry after NSF funding has stopped. This would provide the forum for the exchange of ideas and technology without governmental intervention, which was the original intention of the program.

The next logical question would be to ask why individual companies would be interested in continued involvement with and monetary support

of the center. There are many reasons why a company might choose to continue to financially support a center. These reasons may involve factors beyond the control of the individual company. The economic climate, for instance, may affect a sponsor's decision. If the economy is flourishing, especially in the area of the particular industry, sponsors may find it easier to find support in their companies to allocate monies for research. A particular industry may find it vital to continue center membership to keep abreast of what other companies in the field are doing. Some companies may not have the research facilities or may find it cheaper to conduct certain types of research at university instead of company laboratories.

Certain aspects of the company's relationship with the center and its staff may be the deciding factor in continuing sponsorship. The number of years the sponsor has been involved with the center, or the age of the center, itself, may influence the decision to stay on as a sponsor. These may be deciding factors since the utility of the research for a particular company may be a result of the input about industrial problems from that company over the years, and it may take several years for a center to provide any meaningful research results. The choice may have to do with personal ties to staff members associated with the center, or because of the leadership skills of the director.

Finally, the decision may be based on inputs to and outputs from the center itself. If a sponsor or its representative is highly involved in the activities of the Center, the Center may be more aware of, and therefore, more responsive to that sponsor's needs. Sponsors may also base their decision on the outcomes or benefits they have

realized or expect to realize as a result of their association with the Center, i. e., whether or not they are satisfied with the results of their affiliation with the Center.

It is this final area, involving satisfaction and certain factors which may affect satisfaction, which is examined in greater detail in this study. It would seem that the best single predictor of whether or not a company will continue to support a center is a measure of that company's overall satisfaction with the center. It seems reasonable to assume that a sponsor will be satisfied if the center has fulfilled the intended objectives, that is, technology transfer has taken place and/or trained personnel have been provided. Transfer of technology or personnel does not take place in a vacuum, however. Rather, it requires a dynamic process or interaction between the provider of the resources and the receiver.

While the center must make the resources readily available, the sponsoring company must provide some mechanism for transferring those resources. In most instances, a representative from the company, who is aware of the research and personnel provided by the center, must be the liaison who will present the information to the company, and work within the company to encourage its use and implementation. Occasionally, the research results may be presented at the company by the center researcher for all interested employees. It would appear, therefore, that the amount of participation, by the company and the company representative, aids in assuring the successful transfer of research results. Further, sponsor satisfaction is dependent on the amount of such outcomes realized as a result of center affiliation.

Keeping this dynamic process in mind, a model has been constructed which hypothesizes relationships between company participation and research outcomes and company satisfaction, specifically, that company participation and research outcomes lead to satisfaction. In the long run, it is believed that the company's satisfaction will influence its decision to continue as a sponsor of a center.

The initial question is whether the data provide a basis to identify the factor of satisfaction as well as the factors related to satisfaction, such as participation and outcomes. The second question is whether the hypothesized model of the relationships among these factors is confirmed by the data.

The first part of the model hypothesizes that a greater number of outcomes will result in greater satisfaction. If a company is benefiting from research results provided by the center, satisfaction will be high. The benefits for the companies take several forms. For instance, new company research projects or improvements in current projects may be stimulated by the activities of the center's basic research. Improvements may result in company products and processes due to new technologies discovered by center researchers. There are also other outcomes, such as, exchange of scientific personnel and hiring of center-trained students, which would increase a company's satisfaction. It stands to reason that industrial sponsors will be satisfied if they are getting a reasonable return on their investment. If a company is satisfied, it would not be difficult to get the continued support that the center needs.

It was pointed out earlier that the transfer of technology requires a great deal of communication and participation by both the provider and the receiver of the research outcomes. The second part of the model, then, hypothesizes that the more a company and its representative participate in center activities, the more likely that company would be to realize, what is for the company, desirable outcomes. This appears to be a reasonable assumption, since a participating representative would have more familiarity with the research being done at the center. With this knowledge, suggestions could be made to researchers on how to improve or expand the research to suit that company's needs. With input from other departments within the company, there is a greater likelihood that center research will be geared to specific industrial problems. When research results are presented, the informed representative will be better able to transfer those results to the sponsoring company. An active participant in the center would also be more likely to be acquainted with the students working at the center, and therefore, aware of the potential pool of trained scientists.

Finally, it is hypothesized that greater company participation also leads to greater satisfaction. If representatives are participating in center activities, they will be more likely to identify with the center. This affords them the opportunity to establish close ties with the center's staff, and this enhances satisfaction. The center will also enjoy greater support within the company if top management and other departments have had dealings with the center and its personnel.

This study is an initial effort to examine some of the factors related to the transfer of technology between organizations. It uses

the data from only ten centers, collected from eight centers in 1983 and two in 1986, and should be viewed as a basis for further study of the process of technology transfer through examination of the factors facilitating transfer and the results associated with it.

The remainder of this paper will be divided into four sections or chapters. The first section is the review of relevant literature. This section will cover three areas: relevant literature on program evaluation, the objectives for the UICRC program, and finally, relevant studies in support of the assumptions made about the relationships among the variables. The second section will outline the methods used in this study. This section will consider the respondents, the measurement instruments, and the design of the scales which will be used to represent the variables of participation, outcomes and satisfaction. The next section will present the results of the analysis. This will be divided into two parts. The first part, using the entire group of 99 respondents, will deal with the analysis of the scales themselves, and then with the relationships among the variables for this group of respondents; the second part will analyze the same variables using a subgroup of the initial group who have experienced some results in one of the outcome areas. The final section will attempt to draw conclusions from the results and make recommendations for future research.

CHAPTER 2
REVIEW OF THE LITERATURE

PROGRAM EVALUATION

The first area which will be covered in the review of the literature is program evaluation. Evaluation research systematically applies social science methods to the assessment of programs. Specifically, the evaluation may examine the conceptualization and design of the program, how it is implemented, or its utility (Rossi, 1982, p.20). An evaluation may be required to examine any one or all of the above areas.

One of the reasons for doing program evaluation is to meet accountability requirements of funding groups (Rossi, 1972). As mentioned earlier, NSF provides partial funding for the center for the first five years of its operation, and an evaluation of the centers is required for this period. This evaluation serves several purposes. It provides general information about the UICRC program providing feedback to NSF about the success of the program. It also provides information about the individual centers, and by using these data, NSF is able to make some inferences about the attributes of 'successful' and 'unsuccessful' centers.

According to Rossi (1972), evaluations can be divided into three categories: those related to conceiving and designing interventions; those which monitor program implementation; and those which assess program utility. Since this program has been in effect for several years, the first classification of evaluation would already have been

completed. Although some data are provided to determine whether or not the program is properly implemented, the major thrust of the evaluation is to determine program utility.

When studying program utility, the evaluation can be done in two ways: studying the program as a whole and assessing its effects, or studying variables by selecting certain phenomena which appear important and are appropriate for study (Riecken, 1972). The overall evaluation does the former. The National Science Foundation is able to ascertain the utility of the program by comparing the evaluation across the centers. Weiss (Evaluation Research, 1972), however, states that merely testing a program without exploring the concepts or variables on which it is based, does nothing to expand understanding or increase knowledge. The present study attempts to identify and examine some of the variables which will impact on the satisfaction of the sponsors. It is intended that this exploration of the relationships among the variables provide information as to why some centers are more successful than others at keeping the corporate sponsors content with the activities of the center. This would, in turn, increase understanding of the success of the program as a whole.

The first step for an evaluator is to outline the objectives of the program (Rossi, 1972; Weiss, Evaluation Research, 1972). The objectives can be classified according to three levels of generality: immediate goals refer to services to be delivered; intermediate goals refer to the accomplishments realized because of the efforts of the service providers; and the ultimate goals are set by policy makers and are aimed

at alleviating a general problem (Suchman, 1972). The objectives of the UICRC program are discussed in the following section.

Once the objectives are clearly defined, the evaluator must decide on the evaluation design. An experimental design, with a randomly selected experimental and control group, is a superior and preferred design if it is feasible (Campbell, 1977). The overall NSF evaluation, however, with continual feedback is considered a continuous or process evaluation. This type of evaluation neither requires nor permits an experimental design. Instead of a 'before - after' design, a 'during - during - during' design provides continual feedback to assess the impact of program activities and changes (Suchman, 1972). For this study, in which several variables will be isolated and analyzed, the evaluation takes on a quasi-experimental nature. A quasi-experimental design is one in which random assignment and complete mastery and control of the variables by the experimenter is not possible, (Campbell and Stanley, 1955). Since, by its nature, the quasi-experimental design lacks control, the results must be viewed in light of other plausible rival hypotheses which may account for the relationships which are observed.

At this point, it is necessary to identify several outcome measures which represent the objectives of the program (Rossi, 1972). For the present study, it has been suggested that a measure of satisfaction would be the best single predictor of whether or not a company will continue to support a center. Since the continuation of a center beyond the NSF funding phase is an intermediate objective for this program, satisfaction is a reasonable outcome to examine.

A next phase involves specifying and measuring the conditions

between program inputs and outcomes. The assumption is that if this 'condition' or 'variable' is present, outcomes will improve. One way to decide which variables to measure is to construct a model to identify the steps which are involved in making the program work (Weiss, Evaluation Research, 1972). For the present study, a model has been constructed which hypothesizes that both participation and outcome affect satisfaction, and further, that the amount of participation will also affect the number of outcomes which are realized.

With a model to describe the expected relationships, measurements of the variables must be provided in order to continue the analysis. The measures can be obtained from many sources including existing data and data gathered from structured questionnaires (Rossi, 1972). For this purpose, the Industrial Sponsor Questionnaire, which is used yearly across the University/Industry Cooperative Research Centers for the entire NSF evaluation, will be used as the source for information concerning the three variables. The measures must be assessed for reliability and validity before using them to examine the hypothesized relationships. Invalid measures will not provide any information about the desired relationships. Unreliable measures will obscure the real effects of a program (Rossi, 1972).

OBJECTIVES

As mentioned previously, the first step in undertaking any evaluation is to define the objectives. For this reason, it would be helpful to review the early literature regarding the cooperative

research efforts of industry and universities in order to outline the objectives intended by the government in encouraging such cooperation.

With increasing foreign competition, it became apparent that the United States required some strategy to produce new technologies and increase the speed at which this new knowledge was incorporated into the industrial sector. In 1972, President Nixon commissioned the National Science Foundation and the National Bureau of Standards to explore new ways to encourage non-Federal investment in research and development (Colton, 1982). The NSF created several programs designed to encourage linkages between university and industrial scientists. One of these programs was the University-Industry Cooperative Research Centers (UICRC) Program. The ultimate objective of this program is to strengthen the total science capability of the Nation (National Science Foundation, 1976).

The UICRC's program was intended to link the university scientist with the research needs of industry by providing administrative structures within the universities which were to act as the liaison (National Science Board, 1982; National Science Foundation, 1976; Colton, 1982). If the Centers were able to fulfill the expectations of the university and of industry in this cooperative effort, the program would be successful. The intermediate goal would be for the Centers to continue operating with funds from industry after NSF funds have been terminated (Colton, 1982).

The immediate objectives are the services or benefits provided to those participating in the program. For the university, a great advantage is the acquisition of an alternative means of funding

(National Science Board, 1982; Colton, 1982; Langfitt, 1983). This is vital in a time when federal funding for research is fluctuating. By apprising university scientists of the basic research needs of industry, the direction of research and the educational emphasis of the university is established (National Science Board, 1982). In this way, faculty and students are provided an opportunity to participate in R&D for industry (National Science Foundation, 1976; National Science Board, 1982; Colton, 1982). Teaching and research are improved through the information supplied by industry about the latest applications in the field (Low, 1983). These close ties with industry will serve to improve training for students (National Science Board, 1982; Fusfeld, 1983), as well as apprise them of industrial career opportunities (National Science Foundation, 1976).

Industry also has a great deal to gain from the cooperative research effort with universities. Universities can supply industry with fundamental knowledge which could be built upon for future technical programs (National Science Board, 1982; Fusfeld, 1983; Press, 1983). With access to this new source of knowledge, it is hoped that technology will move to the marketplace more rapidly (National Science Board, 1982; Colton, 1983; Fusfeld, 1983). Finally, but certainly not least important, universities would provide a pool of trained personnel with a store of fundamental knowledge, yet aware of the industrial research needs associated with a particular field (Fusfeld, 1983; Low, 1983; Press, 1983).

SUPPORT LITERATURE

It is hypothesized that a greater number of outcomes will result in greater satisfaction. The strongest evidence for this statement is personal conversations this researcher has had with corporate sponsor representatives. The understanding is that the greater the amount of technology transfer, the greater the satisfaction. Although industry views research as a long-term investment, ultimately the research is expected to pay off in terms of a product, process, or service which will improve corporate performance (National Science Board, 1982). This is because industry is output oriented, and increased efficiency in production of goods and services must be realized for research to be effective (Low, 1983). Further, industries are interested in the access to manpower in the form of trained personnel provided by the centers (National Science Board, 1982, Fusfeld, 1983, Press, 1983). If tangible benefits are realized within the sponsoring company, it is much easier for the representative to get the backing within his company to continue financial support of the center. If no results are experienced, it becomes more difficult to justify the financial outlay, since it is necessary for industries to show a return on their investment (Maugh, 1985).

The social psychological literature supports the assertion that a greater number of outcomes or rewards resulting from small group membership leads to greater satisfaction and morale on a personal level (Collins, 1964; Exline, 1957, Marquis, Guetzkow, and Heyns, 1951). Further, one major influence of the decision of a individual to remain a member of the group is the outcome gained from group membership

(Thibaut and Kelly, 1959). This whole concept is underscored by the Exchange Theory in small groups, which states that mutually satisfying patterns of reward/cost will encourage group emergence and will enhance group cohesiveness and continuity (Homans, 1961).

This literature generally refers to individuals in small groups and does not make reference to the interorganizational situation which is the focus of this study. It does not seem unrealistic, however, to generalize these basic principles of increased outcomes leading to greater satisfaction to the individual company sponsors of a center, especially since the relationship is carried out by specific individuals. If their expectations regarding research results are being met, they will be more likely to be satisfied with the center, and therefore, more likely willing to continue center membership.

A review of the literature relating to technology transfer underscores the importance of communication in the successful transfer of research results. A second part of the hypothesis presented in this paper is that a greater amount of participation by the individual sponsor representatives and by the functional groups within the company will be associated with a greater number of outcomes resulting from center membership.

McGuire and Kench quote Tom Burns, who notes that "the mechanism of technological transfer is one of agents, not agencies" (McGuire and Kench, 1981, p. 13). It becomes clear that greater participation in center activities by the sponsor representative will result in increased contact and interaction with center faculty and staff. This, in turn,

provides a more informal forum for the exchange of ideas and a discussion of research needs and objectives. This is essential, because in the problem definition stage of technology transfer, a dynamic equilibrium must be present in the partnership between the innovator [university] and the user [industry]. That is, there must exist a balance between the "push" from the innovator and the "pull" from the user (Lambright, 1976). Further, the recipient's inability to identify and specify research needs may seriously impede the successful transfer of technology (Morone and Ivins, 1982). Through the individual representative, the company can be highly involved in the project definition stage and can remain in contact throughout the life of the research project. This is not only the desire of industry, it makes technology transfer a part of a process rather than something to be accomplished after the research is completed (Boyle, 1986).

Once the research results have been presented, successful innovation within the company often depends on a 'product champion'. Chakrabarti and Reubenstein describe the product champion as an individual who goes beyond his formal organizational role, providing a bridge between the organizations, to promote the product idea (Chakrabarti and Reubenstein, 1976). This role would most likely be played by the sponsor representative who has contacts with both the innovator and the user. If this representative is a party to the research process, he will be more likely to accept this role.

Along with the important exchange of information at the problem definition stage, the contacts and interactions between industrial representatives and researchers will help to forge friendships which

form a basis for trust and loyalty. This provides an atmosphere where an exchange of research findings is more easily and smoothly accomplished (McGuire and Kench, 1981, Czepiel, 1975).

Within the literature, there is also some support for the assumption that higher amounts of participation of top management and functional groups within the company will increase certain types of outcomes. It is noted that especially in the development of products, interaction and cooperation is necessary among several functional groups within the organization, such as engineering, production, and marketing. Further, because of the need for a greater commitment of resources for new products, top management participation plays a more important role in product innovations (Chakrabarti and Reubenstein, 1976).

Finally, it is hypothesized that increased participation will result in increased satisfaction. It is once again necessary to refer to the social psychological literature in addressing this issue. The literature states that more favorable attitudes toward a group were detected if the group member had been participating in the decision-making process of the group (Bass and Leavitt, 1963). Since sponsoring companies, through their participation, can have some impact on administrative activities as well as project selection and problem definition, it is safe to assume that satisfaction levels would be higher as participation levels increased. In fact, the National Science Board goes on to state that many unsuccessful university/industry interactions are the result of "a communication gap resulting from a lack of time and effort put into building up a trust relationship between the two parties" (National Science Board, 1982, p 12).

It is noted in small groups that as the frequency of interaction increases, liking for each other also increases (Homans, 1950). When groups are highly cohesive, satisfaction with the group increases, and when high satisfaction is present, loyalty increases (Ridgeway, 1983, Shepherd, 1964). As mentioned earlier, the bonds of traditional loyalty, friendship and trust which are formed through the contacts among the center participants provide the atmosphere in which the objectives of the center are more likely to be realized (McGuire and Kench, 1981).

Study Objectives and Hypotheses

Since the instrument which provides the data for this study contains groups of questions that seem to relate to the each of these variables of participation, outcomes, and satisfaction, scales can be constructed using these items to provide an overall index for each variable. These indices would be a useful tool to study the relationships among the variables. The first objective of this study is to construct scales as a measure of the variables, and then analyze the scales as to their robustness.

The second objective is to determine if the hypothesized relationships among the variables are confirmed by the data. These hypotheses are specified below.

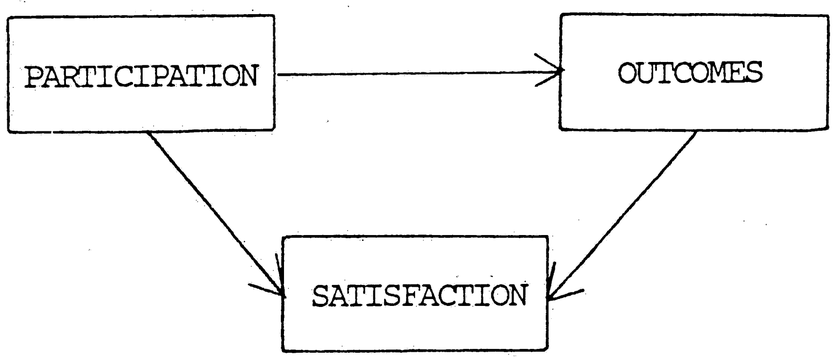
A greater number of outcomes realized by a corporate sponsor will be associated with higher satisfaction. Since each corporate sponsor has a financial investment in the center, it seems reasonable to assume that

satisfaction will be greater if there is a higher return on that investment.

The more actively a corporate sponsor and its representative participate in the center's activities, the more likely it is that the company will realize a greater number of outcomes. Through open communication between sponsors and center personnel, specific problems or needs of a sponsoring company can be addressed, ensuring that the resulting research findings are more pertinent to that company's needs. With technology transfer requiring communication and interaction among the participants, it follows that greater participation will then facilitate the transfer of these research findings.

Greater participation in center activities will result in greater satisfaction. Participating sponsors, who feel they have an impact on center policies and research decisions will be more likely to identify with the center. The sense of being a partner in the administrative activities of the center will result in closer ties to the staff, a feeling of greater responsibility for the successful operation of the center, and finally, in greater satisfaction.

Resulting Model



CHAPTER 3
METHODS

This study was conducted to examine the interrelationships between the level of participation, the number of perceived outcomes, and corporate sponsor satisfaction. To do this it was necessary to develop scales for participation, outcomes, and satisfaction.

Questionnaires developed by NSF, used for the evaluation of the centers, provided the data for this study. A copy of this questionnaire can be found in Appendix 1. The respondents were the corporate sponsor representatives of ten (10) university/industry cooperative research centers. From these questionnaires, all questions dealing with participation, outcomes, and satisfaction were identified. Scales were then constructed to provide indices for these variables so further studies could be done regarding the relationships among them.

Respondents

The data base used for this analysis includes the responses of 160 corporate sponsor representatives. One hundred thirty-three (133) of these respondents were associated with eight centers which were evaluated in 1983. These centers included:

1. The Center for University of Massachusetts/Industry Research on Polymers,
2. The Center for Interactive Computer Graphics (Rensselaer Polytechnic Institute),
3. The Center for Welding Research (Ohio State University),
4. The Center for Applied Polymer Research with Industry (Case Western Reserve University),

5. The University/Industry Cooperative Center for Robotics (University of Rhode Island),

6. The Ceramics Cooperative Research Center (Rutgers University),

7. The Center for Communications and Signal Processing (North Carolina State University), and

8. The Material Handling Research Center (Georgia Institute of Technology).

The other twenty-seven (27) respondents were the corporate sponsor representatives associated with the two University/Industry Cooperative Research Centers at Lehigh University which were evaluated in 1986, namely:

1. Chemical Process Modeling and Control Research Center, and

2. The Center for Innovation Management Studies.

The author has had the opportunity to assist in the evaluation of these two centers at Lehigh University. The evaluation procedure, as it is carried out at Lehigh is outlined below.

Evaluation Procedure

The National Science Foundation provides, as a part of the funding grant to the centers, that each center should engage an evaluator to carry out the mandated evaluation activities. This evaluator is most often located in another department at the same university as the center.

Specific questionnaires are provided by NSF for each of the five groups of participants in the center. These groups are: corporate sponsor representatives, faculty, director, administrative staff, and students. These questionnaires are to be completed each year for the first five years of the center's existence.

For the evaluation of the two centers at Lehigh University, the questionnaires are distributed by mail two weeks prior to the Corporate Sponsors' Meeting. This meeting brings together the center participants on a regular basis, usually, semi-annually. It provides a forum for the discussion of research progress reports, completed results, and suggested new topics. It also allows for interaction of the corporate representatives with each other, with the faculty, center staff, and with the evaluator. At this time, the evaluator is able to collect the completed questionnaires, as well as answer questions, and follow up on delinquent questionnaires. This also provides an opportunity for the evaluator to meet with the participants more informally and collect information which provides a more complete picture of the sponsors' perceptions of center activities.

The first follow-up for questionnaires not returned by the end of the Corporate Sponsors' Meeting takes place in the form of a printed reminder. Finally, the participant is contacted by phone.

After the data have been collected, they are coded, keyed, and analysis is done using SPSS. A report, including tables with item frequencies and a textual explanation is prepared and offered to the center for distribution. Also, copies of the raw data are forwarded to North Carolina State University, where the research team, headed by Dr. Denis Gray, analyzes the data across centers.

Because NSF has allowed that each evaluator use his/her own discretion, evaluation activities across centers may differ somewhat. There may be some differences as to when and how the questionnaires are distributed and collected, although an identical questionnaire is used

to which center-specific questions may be added.

Instruments

The data were gathered from the Output/Structure Questionnaire, which was developed by NSF and is completed by all center participants as a part of the ongoing evaluation of the centers.

The purpose of this questionnaire is to understand the relationship of the center with its industrial sponsors. The data gathered from this questionnaire provide information to help understand the overall program of the center, and to assess the various results and benefits accrued to the university and companies from participation in the center.

Scale Design

The questionnaires were examined to determine which of the items dealt with the relevant areas. Fourteen (14) items were isolated for the participation scale, seventeen (17) for the outcome scale, and six (6) items for the satisfaction scale.

The fourteen items for the participation scales are listed below.

During the past year what functional groups in your company worked directly with the Center? (CODE: Yes = 2; No = 1, for each of the seven functional groups)

1 - Central R&D Staff
2 - Divisional R&D Staffs
3 - Production Staff
4 - Marketing Staff
5 - Engineering/technical Staff
6 - Corporate planning Staff
7 - Other

8 - To what extent is your top management involved with the activities of the center? (CODE: Completely = 4; Considerably = 3; Somewhat = 2; Not at all = 1)

Do you currently take an active role in any of the following activities of the center? (CODE: Yes = 2; No = 1, for each activity)

9 - Recruitment of new member companies
10 - Organizing meetings
11 - Proposal writing
12 - Planning
13 - Building support within the university
14 - Other

The questionnaire also yielded seventeen (17) items on perceived outcomes. These items are listed below.

1 - During the past year, approximately how many new research projects have been stimulated in your research laboratories by center activities? (CODE: 1 and higher = 2; 0 = 1)

2 - During the past year has participation in the Center activities stimulated other outside research contracts with faculty or another laboratory? (CODE: Yes = 2; No = 1)

During the past year to what extent has the research conducted at the center caused changes in the R&D projects in your company? (CODE: A lot = 4; Some = 3; A little = 2; Hardly Any = 1, for each area changed)

3 - Research topics and issues
4 - Research methods and procedures used
5 - Criteria and methods used to evaluate research projects

During the past year has your participation in the Center had any effect on the following in your company? (CODE: Significant = 3; Moderate = 2; No effect = 1, for each area)

6 - Improvements in products and services
7 - Changes in warranty & complaints in view of improvements in products
8 - New products developed due to related efforts
9 - Changes in cost of products to users (price changes or decreased product maintenance)
10 - Reduction of production costs
11 - Improvement in processes and methods of production
12 - Increased uniformity of products
13 - Improved product or process design

14 - During the past year how many students trained in the Center research projects have been interviewed for possible employment in your company? (CODE: 1 or more = 2; 0 = 1)

15 - How many have actually been hired? (CODE: 1 or more = 2; 0 = 1)

16 - During the past year how many university scientists from the Center have spent time working on-site in your company labs? (CODE: 1 or more = 2; 0 = 1)

17 - How many scientists from your company have spent time working on-site at the Center? (CODE: 1 or more = 2; 0 = 1)

The questionnaire included six (6) items involving satisfaction. These items are as follows:

1 - During the past year how would you rate the overall research program in the Center compared to similar research programs in other U. S. universities? (CODE: Top 2% = 4; Top 10% = 3; Above average = 2; Below average = 1)

During the past year how satisfied were you with the following features of the Center? (CODE: Completely satisfied = 4; A great deal = 3; Somewhat = 2; Not at all satisfied = 1, for each feature)

2 - Technical quality of the research
3 - Communications between Center staff and your company
4 - Center administrative practices
5 - Responsiveness of the Center to industry needs

6 - To what extent are you generally satisfied with the operations and activities of the Center? (CODE: Completely satisfied = 4; Considerably = 3; Somewhat = 2; Not at all satisfied = 1)

The items in each scale were analyzed individually by examining the the means, standard deviations, and range. They were then divided into subscales using factor analysis as a guide, and reliabilities were run on these subscales. The factor analysis, however, provided subscales in

which the items were not linked conceptually. The items were then reformed into subscales which made sense conceptually in order to enhance the interpretability of the analysis. These subscales were:

1) Company Participation
2) Individual Participation
3) Changes in Research
4) Changes in Products and Processes
5) Personnel Exchange
6) General Satisfaction

Each of these subscales was then analyzed using ATSCALE, a computer program (Burns, 1973) which provides indices of internal consistency, reproducibility, reliability, and single-factoredness. Reliabilities were also run using the Statistical Package for the Social Sciences (SPSS).

The subscales were then recombined to determine if the recreated overall scale could be used as an index for each variable. A factor analysis was run on each scale using a single factor. On the basis of this factor analysis, two of the participation items and five of the outcome items were dropped from the scales and subscales. Because four of the five items to be dropped from the outcome scale comprised the personnel exchange subscale, this subscale was kept separate from the overall index for outcomes, but was used separately in further analysis. The ATSCALE program was used to analyze these overall scales, and reliabilities were run on SPSS.

Statistical Procedures

Pearson Correlations were run on the two participation, the three outcome, and the satisfaction subscales. Because of an unexpected negative correlation between the Product and Process Outcome Subscale

and the Satisfaction Scale, a scattergram of this relationship was examined. Analysis of this scattergram showed that those respondents who had 'no effect' in this area varied greatly in their levels of satisfaction. This lack of relationship between this outcome subscale and satisfaction changed, however, when those respondents who experienced at least some outcome were examined. A relationship was now noted which appeared to be a positive one. It was then decided that the analysis would continue using the original group of respondents, as well as the group of respondents who reported at least some effect in the Products and Process Outcome subscale. The number of the original respondents, after those with missing data were eliminated, was 99; when the group with 'no effect' in the second outcome subscale were eliminated, the number was 41.

Another analysis was done using two-way analysis of variance. The respondents were broken into groups relating to: low participation/low outcomes, high participation/low outcomes, low participation/high outcomes, and high participation/high outcomes. The dependent variable was the satisfaction scale.

Finally, multiple regression was done regressing the satisfaction scale on simple combinations of the participation and outcome subscales. The satisfaction scale was then regressed using all of the subscales as independent variables, and lastly, on the overall participation and outcome scales. As mentioned earlier, all of these analyses were done with the entire group of respondents as well as those who had experienced at least some effect in the Products and Process Outcome Subscale.

Missing Data

One of the problems dealing with this data involved the number of missing values. Missing data are particularly problematic when dealing with scales which require a composite of several variables. A missing value on any one variable will cause that respondent to be eliminated from the scale analysis as well as the final analysis of the variables.

There were two types of missing data in this analysis. One type involved responses which were left blank. Another type of missing data involved the response "not applicable" or "don't know". These response types were each dealt with in a different way.

When a response was left blank, it was reasoned that the respondent preferred to say nothing at all rather than say something negative about the center. In many instances, if an outcome had been realized, it had been indicated, while other outcomes were left blank. It was assumed on this basis, that a blank would have been equivalent to "no effect". Under this assumption, all blanks were recoded to the level which represented "no effect".

The second type of missing value was somewhat more difficult to deal with. Several items included responses such as "not applicable" or "don't know". For example, a respondent may have answered a great deal about the outcomes received by the company, but an area or two did not apply to the particular industry, or the respondent was unaware if there was a result or not. Because of these few instances, the respondent would have been eliminated from the scale analysis. For this type of missing data, a count was done of the number of responses for each

respondent which fell into this category. On a subscale-by-subscale basis, if the missing responses did not encompass more than twenty percent of the total responses for that subscale, those "missing" responses were recoded to the level of response which represented "no effect".

After dealing with the missing data in this way, 99 of the original 160 respondents remained to be included in the analysis.

CHAPTER 4
RESULTS

The results of the statistical procedures will be reported in two sections. The first section will deal with the entire group of 99 respondents. The development of the scales and subscales will be discussed, and the analysis of the individual scales will be presented. After this, these subscales and scales will be used to examine the interrelationship among the variables for the entire group of 99 respondents. The second section will use the same scales and subscales to analyze the relationships that exist among the 41 respondents who have exhibited at least some effect in the Products and Process Outcome subscale.

Development of Scales

After the questions dealing with participation, outcomes, and satisfaction were isolated, they were separated into scales which contained fourteen (14) items for participation, seventeen (17) items for outcomes, and six (6) items for satisfaction. A factor analysis using a single factor was done on each of these subsets of items, and the mean, standard deviation, and range for each item was computed. The scales were then further divided into subscales in which the items were grouped conceptually. For ease in distinguishing between items, subscales, and scales in further discussions, the items will be presented in single quotes, i. e., 'Item', the subscales will be presented in double quotes, i. e., "Subscale", and the overall scales will be in upper case letters, i. e., SCALE. The factor loadings and the

descriptive statistics for the items grouped by subscales are located in Table 1.

The first participation subscale, labeled "Company Participation", has seven dichotomous items and one multilevel item. The factor loadings show that the highest loading for the participation factor is on 'Divisional R&D Working with the Center' at .42. Two of the loadings, marked with an asterisk, are very low; one of these is negative. These two variables, 'Corporate R&D Working with the Center' and 'Production Staff Working with the Center', with loadings of .07 and -.05 respectively, were dropped from the subscale and overall PARTICIPATION scale for subsequent analyses. Of the six remaining items included in the "Company Participation" subscale, the lowest loading is .15 for 'Corporate Planning Working with the Center'.

The second subscale is given the label, "Individual Participation", and represents the company sponsor representative's involvement in center activities. All of these items are dichotomous, 1 meaning the representative is not involved in the particular activity, 2 meaning there is involvement. All of these six items are included in the overall PARTICIPATION scale. The factor loadings for these items range from .58 in 'Organizing Meetings' to .20 for 'Other Activities'.

There are three outcome subscales. The first subscale deals with "Changes in Research". Originally, five items were included in this subscale. After examining the factor loadings which used a single factor to describe the outcome construct, it is noted that the item, 'Outside Contracts Stimulated' has a negative loading of -.07. This

TABLE 1: FACTOR LOADINGS, MEANS, STANDARD DEVIATIONS, AND RANGES FOR ITEMS IN PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES, N=99.

PARTICIPATION	FACTOR LOADING	MEAN	SD	RANGE
"Company Participation"				
Divisional R&D work with Center	.42	1.28	.45	1,2
Engineering Staff work with Center	.33	1.37	.48	1,2
Involvement of top management	.29	1.84	.70	1,4
Marketing Staff work with Center	.26	1.08	.27	1,2
Other groups work with Center	.20	1.06	.24	1,2
Corporate Planning work with Center	.15	1.07	.25	1,2
Corporate R&D work with Center	.07*	1.46	.50	1,2
Production Staff work with Center	-.05*	1.05	.22	1,2
"Individual Participation"				
Organizing meetings	.58	1.19	.39	1,2
Planning	.57	1.34	.47	1,2
Proposal writing	.45	1.07	.25	1,2
Building university support	.34	1.03	.17	1,2
Recruitment of new members	.24	1.08	.27	1,2
Other activities	.20	1.17	.37	1,2
OUTCOMES				
"Changes in Research"				
New projects stimulated	.63	1.41	.49	1,2
Changes in research methods	.31	1.55	.77	1,4
Changes in research topics	.29	1.80	.87	1,4
Changes in evaluation criteria and methods	.22	1.48	.71	1,4
Outside Contracts stimulated	-.07*	1.14	.35	1,2
"Changes in Products and Processes"				
Increased product uniformity	.83	1.20	.47	1,3
Improvements in processes and methods	.74	1.31	.61	1,3
Improved products and process design	.71	1.38	.65	1,3
Improved products or services	.65	1.31	.61	1,3
New products developed	.65	1.28	.60	1,3
Reduction in production costs	.65	1.26	.58	1,3
Changes in cost to users	.64	1.14	.40	1,3
Changes in warranties or complaints	.49	1.08	.30	1,3
"Personnel Exchange"				
Number of company scientists at the university	.15*	1.17	.37	1,2
Number of students interviewed	-.01*	1.38	.48	1,2
Number of students, faculty at company labs	-.02*	1.32	.47	1,2
Number of students hired	-.15*	1.13	.33	1,2

* These items were eliminated because of low factor loadings.

Continued

TABLE 1: FACTOR LOADINGS, MEANS, STANDARD DEVIATIONS, AND RANGES FOR ITEMS IN PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES, N=99.

SATISFACTION	FACTOR LOADING	MEAN	SD	RANGE
Satisfied with responsiveness of Center	.70	2.67	.83	1,4
General Satisfaction	.68	2.88	.63	1,4
Satisfied with administrative practices	.67	2.89	.85	1,4
Satisfied with technical quality	.59	2.90	.75	1,4
Satisfied with communication links to Center	.56	3.03	.80	1,4
Overall Rating	.35	2.39	.81	1,4

item was dropped from the subscale and the overall OUTCOME scale since it appears not to be an indicator of a single outcome factor. The loadings of the items which were retained range from .63 for 'New Projects Stimulated' to .22 for 'Changes in Evaluation Criteria and Methods'.

The second subscale for outcomes includes "Changes in Products and Processes" as a result of center research. All of the factor loadings for the outcome factor are rather high for this group of eight items, and therefore, all of the items were retained. The highest loading appears for 'Increased Product Uniformity' with a loading of .83, and the lowest loading is for 'Changes in Warranties or Complaints' with a loading of .49.

The final outcome subscale reflects "Personnel Exchange" between the center and corporate sponsors. The highest loading for the single outcome factor is only .15 for 'Number of Company Scientists at the University'. The remaining three variables all have negative loadings ranging from -.01 to -.15. Since these items do not seem to describe a single outcome factor, they have been dropped from the overall OUTCOME scale. This subscale was kept intact, however, and used separately in the final analyses.

The SATISFACTION scale consists of six multilevel items with a range of 1 to 4. These items were included in a factor analysis using a single factor to describe the construct of satisfaction. All of the items loaded positively on the single factor. The highest loading was on the item 'Satisfied with Responsiveness of Center' with .70, and the

lowest loading was on 'Overall Rating' with a loading of .35. With only six items in the overall SATISFACTION scale, these items were not further divided into subscales.

Once the items had been decided upon as described above, the scales and subscales were formed by simply totaling the scores of each of the included items to provide each respondent with a total score. The means, standard deviations, and ranges of the reconstructed subscales and the overall scales are given in Table 2.

These scales and subscales were then subjected to analysis using the ATSCALE program (Burns, 1973). This program provides statistics with which to judge the reproducibility, reliability, and unidimensionality of the scales.

Table 3 reports the statistics provided by ATSCALE for all of the subscales, and Table 4 gives these statistics for the overall scales. As mentioned previously, the "Satisfaction" subscale and overall SATISFACTION scale are the same, since all the items are included in both.

The coefficient of reproducibility, which is the statistic for the Guttman test, ranges from .88 for the "Satisfaction" subscale to .95 for the subscale involving "Changes in Research". The overall PARTICIPATION scale has a coefficient of .91 and the overall OUTCOME scale is .89. The Green Index, which provides another index of reproducibility for these scales has much lower scores in four of the five subscales with scores in the .24 to .29 range. The "Changes in Research" outcome subscale has a better score with .49, and the "Changes in Products and Processes" outcome subscale has the highest score

TABLE 2: MEANS, STANDARD DEVIATIONS, AND RANGES FOR PARTICIPATION, OUTCOME,AND SATISFACTION SUBSCALES AND SCALES WITH SELECTED VARIABLES INCLUDED, N=99.

	# OF VAR	MEAN	SD	RANGE
PARTICIPATION	12	14.60	2.03	12,21
"Company Participation"	6	7.71	1.34	6,12
"Individual Participation"	6	6.88	1.11	6,10
OUTCOME	12	16.24	4.29	12,31
"Changes in Research"	4	6.26	2.15	4,13
"Changes in Products & Processes"	8	9.98	3.14	8,22
"Personnel Exchange"	4	5.01	1.08	4,8
SATISFACTION	6	16.79	3.17	10,24
"General Satisfaction"	6	16.79	3.17	10,24

TABLE 3: ATSCALE RESULTS ON PARTICIPATION, OUTCOME AND SATISFACTION SUBSCALES, N = 99.

INDEX	COMPANY PARTICIPATION	INDIVIDUAL PARTICIPATION	OUTCOMES/ RESEARCH	OUTCOMES/ PRODUCT & PROCESS	OUTCOMES/ PERSONNEL EXCHANGE	GENERAL SATISFACTION
Number of variables	6	6	4	8	4	6
Coefficient of Reproducibility	.94	.94	.95	.93	.92	.88
Green Index	.29	.24	.49	.53	.28	.26
Kuder-Richardson 20	.46	.52	.55	.86	.51	.66
Cronbach's Alpha	.44	.52	.72	.86	.51	.76
Inferred average Inter-item Correlation	.11	.15	.39	.45	.21	.34
Corrected Item/Total Correlations	.20 .33 .26 .23 .13 .28	.08 .42 .28 .56 .24 .10	.37 .50 .60 .60	.64 .45 .58 .61 .65 .69 .75 .66	.22 .34 .40 .28	.30 .54 .47 .54 .58 .60
Lawley's Chi-Square prob.	.142	.431	.001	.001	.001	.001
Wolins Index	.87	.83	.86	.89	.76	.88

TABLE 4: ATSCALE RESULTS ON OVERALL PARTICIPATION, OUTCOME AND SATISFACTION SCALES, N=99.

INDEX	PARTICIPATION	OUTCOMES	SATISFACTION
Number of variables	12	12	6
Coefficient of Reproducibility	.91	.89	.88
Green Index	.20	.31	.26
Kuder-Richardson 20	.61	.82	.66
Cronbach's Alpha	.60	.82	.76
Inferred average Inter-item Correlation	.11	.28	.34
Corrected Item/Total Correlations	.33 .28 .31 .18 .14 .29 .24 .37 .29 .34 .21 .21	.40 .39 .42 .35 .53 .43 .60 .49 .49 .58 .70 .59	.30 .54 .47 .54 .58 .60
Lawley's Chi-Square prob.	.001	.001	.001
Wolins Index	.87	.79	.88

at .53. The overall PARTICIPATION scale has only a .20 score on the Green Index, while the overall OUTCOME scale is .31, and the SATISFACTION scale is .26.

The reliability measures include the Kuder-Richardson 20 and Cronbach's alpha. In order to do the Guttman test, all of the multilevel items are given a level at which they are dichotomized. The Kuder-Richardson 20 gives the reliability for the subscales if the items are dichotomized in this manner. These reliabilities range from .46 on the "Company Participation" subscale to .86 on the "Changes in Products and Processes" outcome subscale. The overall PARTICIPATION, OUTCOME, and SATISFACTION scales have KR-20's of .61, .82, and .66 respectively.

Cronbach's Alpha gives the reliability for the scales with all levels of responses included. There is not a great deal of change in the participation subscales from the Kuder-Richardson 20, since the first subscale is dichotomous except for one item, and the second subscale contains all dichotomous items. The third outcome subscale, which deals with "Personnel Exchange", also remains the same as the Kuder-Richardson 20 since it also contains only dichotomous items. The first two outcome subscales, however, have improved reliabilities when the multilevel responses are considered. "Changes in Research" increases from .55 on the KR 20 to .72 on Cronbach's Alpha. "Changes in Products and Processes" increases from .53 to .86. The reliabilities for the overall scales are .60 for PARTICIPATION, a .82 for OUTCOMES, and .76 for SATISFACTION.

These reliabilities were also computed using the Statistical

Package for the Social Sciences (SPSS). These reliabilities, given for the subscales in Table 5A, and for the scales in Table 5B, mirror the reliabilities given by ATSCALE.

The inferred average inter-item correlations are given for all the subscales. They range from .11 on the "Company Participation" subscale to .45 on the "Changes in Products and Processes" outcome subscale. For the overall scales, these statistics are .11 for PARTICIPATION, .28 for OUTCOMES, and .34 for SATISFACTION.

The corrected item-total correlations, which is the correlation of the item with the total of the other items (excluding itself) are all positive, albeit rather low for some items on the participation subscales. For the overall PARTICIPATION scale, all the items correlate between .14 and .37. The OUTCOME items correlate to the total from .35 to .70, and the SATISFACTION items correlate between .30 to .60.

Lawley's Chi-Square probability, if non-significant, is one way of determining if the scale is unidimensional. Only the two participation subscales are non-significant. The outcome subscales have significant chi-squares, and the overall scales have significant chi-squares at the .001 level of significance.

Wolins index probably gives the best index of unidimensionality. This test ranges from .76 on the "Personnel Exchange" outcome subscale to .89 on the "Changes in Products and Processes" outcome subscale. The overall scales have Wolins Index scores of .87 for PARTICIPATION, .79 for OUTCOMES, and .88 for SATISFACTION.

TABLE 5A: RELIABILITY AND NUMBER OF VARIABLES FOR PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES, N=99.*

PARTICIPATION	REL	# OF VAR
Company Participation	.44	6
Individual Participation	.52	6
OUTCOMES		
Changes in Research	.72	4
Changes in Products & Processes	.86	8
Personnel Exchange	.51	4
SATISFACTION		
General Satisfaction	.75	6

TABLE 5B: RELIABILITY AND NUMBER OF VARIABLES FOR OVERALL PARTICIPATION, OUTCOME, AND SATISFACTION SCALES, N=99.*

	REL	# OF VAR
Overall PARTICIPATION	.60	12
Overall OUTCOMES	.82	12
General SATISFACTION	.75	6

* Using SPSS.

Relationships among Scales, N=99

After the subscales and scales had been analyzed, they were used as measurements of the underlying variables of participation, outcome, and satisfaction in order to examine the relationships among these variables.

First, Pearson's Correlation Coefficients were computed using all of the subscales. The matrix for these subscales appears in Table 6A. A correlation of .35 occurs between the "Changes in Research" outcomes subscale and general "Satisfaction". This correlation is significant at the .01 level of significance. Other correlations, significant at the .01 level, occur between "Company Participation" and "Individual Participation", and between Changes in Research" and "Changes in Products and Processes". None of the other correlations are significant. It is also interesting to note that two slightly negative, but non-significant, correlations occur between "Changes in Products and Processes" and "Personnel Exchange", and between "Changes in Products and Processes" and "Satisfaction". The correlations between the overall scales are included in Table 6B. None of the correlations among the scales are significant. The correlations range from .03 between overall OUTCOMES and "Personnel Exchange" to .18 between overall PARTICIPATION and overall OUTCOMES.

In order to examine more closely the effect of the participation and outcome variables on overall satisfaction, a two-way analysis of variance was done. A simple 2 X 2 matrix (Table 7A) was formed by splitting the PARTICIPATION and OUTCOME scales at the median. This resulted in high and low levels of participation and high and low levels

TABLE 6A: PEARSON CORRELATION COEFFICIENTS FOR PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES, N=99.

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Company Participation	1.00					
(2) Individual Participation	.35	1.00				
(3) Outcomes/ Research	.09	.15	1.00			
(4) Product & Process	.14	.09	.28	1.00		
(5) Personnel Exchange	.07	.06	.11	-.03	1.00	
(6) General Satisfaction	.16	.07	.35	-.02	.11	1.00

r = .195, p = .05
r = .254, p = .01

TABLE 6B: PEARSON CORRELATION COEFFICIENTS FOR PARTICIPATION, OUTCOME AND SATISFACTION SCALES, N=99.

	(1)	(2)	(3)	(4)
(1) Overall Participation	1.00			
(2) Overall Outcomes	.18	1.00		
(3) Personnel Exchange	.08	.03	1.00	
(4) General Satisfaction	.15	.16	.11	1.00

r = .195, p = .05
r = .254, p = .01

TABLE 7A: TWO-BY-TWO MATRIX CONTAINING SATISFACTION SCORE MEANS AND NUMBER OF RESPONDENTS IN LOW AND HIGH PARTICIPATION AND OUTCOME CATEGORIES, N=99.

		Outcomes: Low	Outcomes: High
Participation	Low	16.24 n=34	16.91 n=22
	High	17.22 n=23	17.15 n=20

Range for satisfaction scores is 6 to 24.

TABLE 7B: STATISTICS FOR TWO-WAY ANALYSIS OF VARIANCE WITH INDEPENDENT VARIABLES OF OVERALL PARTICIPATION AND OVERALL OUTCOMES, AND A DEPENDENT VARIABLE OF GENERAL SATISFACTION, N=99.

	F	df	p
Participation	1.11	1	NS
Outcome	<1.00	1	NS
Interaction	<1.00	1	NS
Residual		95	
Total		98	

of outcomes. Four cells were formed: low participation/low outcomes, n=34; low participation/high outcomes, n=22; high participation/low outcomes, n=23; and high participation/high outcomes, n=20. The means for overall SATISFACTION were computed for each of these cells, and they are 16.24, 16.91, 17.22 and 17.15 respectively. The two-way analysis of variance is non-significant, indicating that the means of these groups do not differ significantly between those with low and high participation, between those with low and high outcomes, and there is no interaction among the variables. The results of the ANOVA appear in Table 7B.

The final step involved multiple regression. The SATISFACTION variable was regressed on simple combinations of the participation and outcome subscales. Table 8 provides the multiple R, R square change, the f statistic, probabilities, and zero-order correlations for these different combinations. The only area of significance occurs when SATISFACTION is regressed on "Changes in Research" when the variance of either of the participation subscales is partialed out. This is significant at the .001 level of significance. The multiple R for the "Company Participation" and "Changes in Research" combination is .37. The multiple R square, then, is .13, which means that approximately 13% of the variance of the SATISFACTION variable is explained by the combination of these two variables. With the R square for "Company Participation" being only .02, it is obvious that most of the variance comes from the "Changes in Research" variable. The same holds for SATISFACTION regressed on the combination of "Individual Participation"

TABLE 8: REGRESSION OF SATISFACTION SCALE ON COMBINATIONS OF PARTICIPATION AND OUTCOME SUBSCALES, N=99.

Dependent Variable = General Satisfaction

VARIABLE	R^2 CHANGE	F	P	ZERO-ORDER CORREL
Company Participation	.02	2.88	NS	.16
Changes in Research	.11	12.90	.001	.35
R = .37				
Company Participation	.02	2.88	NS	.16
Changes in Products & Processes	.00	0.21	NS	-.02
R = .17				
Company Participation	.02	2.88	NS	.16
Personnel Exchange	.01	1.02	NS	.11
R = .19				
Individual Participation	.00	0.53	NS	.07
Changes in Research	.11	13.15	.001	.35
R = .35				
Individual Participation	.00	0.53	NS	.07
Changes in Products & Processes	.00	0.08	NS	-.02
R = .07				
Individual Participation	.00	0.53	NS	.07
Personnel Exchange	.01	1.14	NS	.11
R = .13				

and "Changes in Research". With a multiple R of .35, all of the predictive power comes from the "Changes in Research" variable since the R square change for the "Individual Participation" variable is .00.

Next, SATISFACTION was regressed using all of the subscales as independent variables. The subscales were entered into the equation in the following order: "Company Participation", "Individual Participation", "Changes in Research", "Changes in Products and Processes", and finally, "Personnel Exchange". The results can be found in Table 9A. Once again, only "Changes in Research" was significant at the .001 level with an R square change of .11. This means that 11% of the variance in the SATISFACTION variable is explained by this independent variable. The multiple R is .41, therefore, these five variables together explain approximately 17% of the variance of SATISFACTION.

The final statistical procedure is the multiple regression of the SATISFACTION scale on the overall scales. The results are in Table 9B. Entered in the order of overall PARTICIPATION, overall OUTCOMES, and "Personnel Exchange", there are no significant f statistics, and the multiple R drops to .22.

Relationships among Scales, N=41

As mentioned in the Methods Section, the negative correlation between the "Changes in Products and Processes" subscale and the SATISFACTION scale for the 99 respondents precipitated a visual examination of the plot of these two variables. It was noted that the group that had "no effect" in this area varied greatly in the level of

TABLE 9A: REGRESSION OF SATISFACTION SCALE ON ALL PARTICIPATION AND OUTCOME SUBSCALES, N=99.

Dependent Variable = General Satisfaction

VARIABLE	R^2 CHANGE	F	P	ZERO-ORDER CORREL
Company Participation	.02	2.88	NS	.16
Individual Participation	.00	0.02	NS	.07
Changes in Research	.11	12.85	.001	.35
Changes in Products & Processes	.02	2.37	NS	-.02
Personnel Exchange	.00	0.34	NS	.11

R = .41

TABLE 9B: REGRESSION OF SATISFACTION SCALE ON PARTICIPATION AND OUTCOME SCALES, N=99.

Dependent Variable = General Satisfaction

VARIABLE	R^2 CHANGE	F	P	ZERO-ORDER CORREL
Overall Participation	.02	2.33	NS	.15
Overall Outcomes	.01	1.84	NS	.16
Personnel Exchange	.00	0.96	NS	.11

R = .22

satisfaction. For those companies who had received at least some effect, however, there appeared to be a significant correlation between "Changes in Products and Processes" and SATISFACTION. This latter group of 41 respondents was isolated for further testing, and the same statistical procedures described earlier were performed upon this group.

The means, standard deviations and ranges of the individual items are given in Table 10, and the same information along with the number of items is included for each subscale and scale in Table 11.

The Pearson's Correlation Coefficient Matrix appears in Table 12A. As suspected, a significant correlation is now found between "Changes in Products and Processes" and SATISFACTION at .36. Also, a highly significant correlation is noted between "Changes in Research" and SATISFACTION at .51 with a probability < .01. "Company Participation" also correlates significantly with SATISFACTION with a correlation of .33. The other significant correlations are between "Individual Participation" and "Company Participation" and between "Changes in Research" and "Changes in Products and Processes". These latter two are the same correlations which were significant for the entire group.

When the overall scales are analyzed using Pearson's Correlation Coefficients, only overall OUTCOMES with SATISFACTION is significant at .51. These results can be found in Table 12B.

The 2 X 2 matrix, which was used for the Analysis of Variance, have cells of n=9 for low participation/low outcome; n=9 for low participation/ high outcome; n=10 for high participation/low outcome; and n=13 for high participation/high outcome. The means are 14.67, 16.44, 14.50, and 17.54 respectively. The analysis of variance is

TABLE 10: MEANS, STANDARD DEVIATIONS, AND RANGES FOR ITEMS IN PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES, N=41.

PARTICIPATION	MEAN	SD	RANGE
"Company Participation"			
Divisional R&D work with Center	1.36	.48	1,2
Engineering Staff work with Center	1.41	.49	1,2
Involvement of top management	2.00	.70	1,4
Marketing Staff work with Center	1.09	.30	1,2
Other groups work with Center	1.07	.26	1,2
Corporate Planning work with Center	1.02	.15	1,2
Corporate R&D work with Center	1.48	.50	1,2
Production Staff work with Center	1.04	.21	1,2
"Individual Participation"			
Organizing meetings	1.26	.44	1,2
Planning	1.43	.50	1,2
Proposal writing	1.12	.33	1,2
Building university support	1.07	.26	1,2
Recruitment of new members	1.04	.21	1,2
Other activities	1.19	.40	1,2
OUTCOMES			
"Changes in Research"			
New projects stimulated	1.53	.50	1,2
Changes in research methods	1.70	.78	1,4
Changes in research topics	1.90	.94	1,4
Changes in evaluation criteria and methods	1.58	.74	1,3
Outside Contracts stimulated	1.09	.30	1,2
"Changes in Products and Processes"			
Increased product uniformity	1.48	.63	1,3
Improvements in processes and methods	1.75	.76	1,3
Improved products and process design	1.92	.72	1,3
Improved products or services	1.75	.76	1,3
New products developed	1.68	.78	1,3
Reduction in production costs	1.63	.76	1,3
Changes in cost to users	1.34	.57	1,3
Changes in warranties or complaints	1.19	.45	1,3
"Personnel Exchange"			
Number of company scientists at the university	1.24	.43	1,2
Number of students interviewed	1.34	.48	1,2
Number of students, faculty at company labs	1.24	.43	1,2
Number of students hired	1.04	.21	1,2

Continued

TABLE 10: MEANS, STANDARD DEVIATIONS, AND RANGES FOR ITEMS IN PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES, N=41.

SATISFACTION	MEAN	SD	RANGE
Satisfied with responsiveness of Center	2.43	.89	1,4
General Satisfaction	2.75	.62	2,4
Satisfied with administrative practices	2.80	.87	1,4
Satisfied with technical quality	2.75	.73	1,4
Satisfied with communication links to Center	3.00	.77	1,4
Overall Rating	2.17	.80	1,4

TABLE 11: MEANS, STANDARD DEVIATIONS, AND RANGES FOR PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES WITH SELECTED VARIABLES INCLUDED, N=41.

	# OF VAR	MEAN	SD	RANGE
PARTICIPATION	12	15.12	2.11	12,21
"Company Participation"	6	7.97	1.33	6,12
"Individual Participation"	6	7.14	1.21	6,10
OUTCOME	12	19.51	4.56	13,31
"Changes in Research"	4	6.73	2.32	4,12
"Changes in Products & Processes"	8	12.78	3.25	9,22
"Personnel Exchange"	4	4.87	1.00	4,7
SATISFACTION	6	15.92	3.18	10,24
"General Satisfaction"	6	15.92	3.18	10,24

TABLE 12A: PEARSON CORRELATION COEFFICIENTS FOR PARTICIPATION, OUTCOME, AND SATISFACTION SUBSCALES, N=41.

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Company Participation	1.00					
(2) Individual Participation	.37	1.00				
(3) Outcomes/ Research	.23	.27	1.00			
(4) Product & Process	.05	-.10	.31	1.00		
(5) Personnel Exchange	-.07	.15	-.02	.11	1.00	
(6) General Satisfaction	.33	.13	.51	.36	-.11	1.00

r = .304, p = .05
r = .393, p = .01

TABLE 12B: PEARSON CORRELATION COEFFICIENTS FOR PARTICIPATION, OUTCOME AND SATISFACTION SCALES, N=41.

	(1)	(2)	(3)	(4)
(1) Overall Participation	1.00			
(2) Overall Outcomes	.13	1.00		
(3) Personnel Exchange	.04	.06	1.00	
(4) General Satisfaction	.29	.51	-.11	1.00

r = .304, p = .05
r = .393, p = .01

significant, and this is because of the main effect due to the outcome variable. These results can be found in Tables 13A and 13B.

When the SATISFACTION variable is regressed on combinations of the participation and outcome subscales, more areas of significance are found. These results appear in Table 14. One notes that "Company Participation" is now significant at the .03 level with an R square change of .11. When "Changes in Research" is entered as the second independent variable, the R square change is . 19, and the multiple R is .55, meaning that this combination of variables explains 30% of the variance in the SATISFACTION variable. "Changes in Products and Processes" is also significant, explaining 11% of the variance when "Company Participation" is partialed out. The squared multiple correlation for this combination of participation and outcome is .22. Because "Individual Participation" is not significant when the SATISFACTION variable has been regressed on it, the same two outcome variables involving "Changes in Research" and "Changes in Products and Processes" remain as significant predictors of SATISFACTION. The multiple R's are slightly lower than the ones involving "Company Participation" because almost none of the variance in SATISFACTION is explained by the "Individual Participation" variable.

When the subscales were used as independent variables, they were entered in the same order as described for the entire group of respondents, that is, "Company Participation", "Individual Participation", "Changes in Research", "Changes in Products and Processes", and finally, "Personnel Exchange". Both "Company

TABLE 13A: TWO-BY-TWO MATRIX CONTAINING SATISFACTION SCORE MEANS AND NUMBER OF RESPONDENTS IN LOW AND HIGH PARTICIPATION AND OUTCOME CATEGORIES, N=41.

		Outcomes: Low	Outcomes: High
Participation	Low	14.67 n=9	16.44 n=9
	High	14.50 n=10	17.54 n=13

Range for satisfaction scores is 10 to 24.

TABLE 13B: STATISTICS FOR TWO-WAY ANALYSIS OF VARIANCE WITH INDEPENDENT VARIABLES OF OVERALL PARTICIPATION AND OVERALL OUTCOMES, AND A DEPENDENT VARIABLE OF GENERAL SATISFACTION, N=41.

	F	df	p
Participation	<1.00	1	NS
Outcome	6.91	1	.01
Interaction	<1.00	1	NS
Residual		37	
Total		40	

TABLE 14: REGRESSION OF SATISFACTION SCALE ON COMBINATIONS OF PARTICIPATION AND OUTCOME SUBSCALES, N=41.

Dependent Variable = General Satisfaction

VARIABLE	R^2 CHANGE	F	P	ZERO-ORDER CORREL
Company Participation	.11	4.95	.03	.33
Changes in Research	.19	10.95	.01	.51
R = .55				
Company Participation	.11	4.95	.03	.33
Changes in Products & Processes	.11	5.79	.02	.36
R = .47				
Company Participation	.11	4.95	.03	.33
Personnel Exchange	.00	0.32	NS	-.11
R = .34				
Individual Participation	.01	0.76	NS	.13
Changes in Research	.24	12.46	.001	.51
R = .51				
Individual Participation	.01	0.76	NS	.13
Changes in Products & Processes	.14	6.46	.01	.36
R = .40				
Individual Participation	.01	0.76	NS	.13
Personnel Exchange	.01	0.73	NS	-.11
R = .19				

Participation" and "Changes in Research" explain significant amounts of the variance of the SATISFACTION variable, with R square changes of .11 and .20 respectively. The multiple R is .60, making the squared multiple correlation equal to .36. That is to say, over a third of the variance of the SATISFACTION variable is explained by these independent variables. These results appear in Table 15A.

Table 16B shows the results of the multiple regression of SATISFACTION on the overall scales. When the scales are combined, only the OUTCOME scale remains a significant predictor of SATISFACTION with an R square change of .23. Combining the scales, however, provides a squared multiple correlation of .33.

TABLE 15A: REGRESSION OF SATISFACTION SCALE ON ALL PARTICIPATION AND OUTCOME SUBSCALES, N=41.

Dependent Variable = General Satisfaction

VARIABLE	R^2 CHANGE	F	P	ZERO-ORDER CORREL
Company Participation	.11	4.95	.03	.33
Individual Participation	.00	0.00	NS	.13
Changes in Research	.20	11.07	.01	.51
Changes in Products & Processes	.04	2.25	NS	.36
Personnel Exchange	.01	0.63	NS	-.11

R = .60

TABLE 15B: REGRESSION OF SATISFACTION SCALE ON PARTICIPATION AND OUTCOME SCALES, N=41.

Dependent Variable = General Satisfaction

VARIABLE	R^2 CHANGE	F	P	ZERO-ORDER CORREL
Overall Participation	.08	3.62	NS	.29
Overall Outcomes	.23	12.97	.001	.51
Personnel Exchange	.02	1.36	NS	-.11

R = .58

CHAPTER 5
DISCUSSION

The significant findings as well as the conclusions which can be drawn from the statistical tests will be dealt with in two sections. First, an interpretation of the results for the entire group of 99 respondents will be presented. This will include the analysis of the scales and subscales as well as a discussion of the relationships among the variables represented by those scales. The second section will present the conclusions about the interrelationships among the variables for the group of 41 respondents. Some speculation will be given as to how the present study could be improved and how the evaluation procedures might be improved. Finally, some suggestions will be made as to how the results of this study can put to use for Center Directors, the National Science Foundation, and the evaluation community.

Scale Analysis

The scales and subscales were analyzed using the group of 99 respondents. These respondents were those who remained after the missing values had been dealt with as described in the Methods Section.

The means of the individual items are generally skewed toward the lower end of the scales. This occurs in all the subscales except for the satisfaction scale in which the means are in the upper half of the range. This can be interpreted in several ways. It is possible that there is not a great deal of participation or outcomes experienced by the sponsors; it is also possible that the full extent of the participation and outcomes has not been reported. There is also the

possibility that some of the assumptions that were made about missing data were not correct, and that missing values were not an indication that no effect was experienced. The higher satisfaction scores reflect a larger amount of satisfaction despite low levels of participation or outcome reported. This may suggest that there may be other factors which affect sponsor satisfaction or that there is the anticipation of satisfaction.

The ATSCALE results which are reported give some indices with which to judge the requirements of a scale. There are three minimal requirements: reproducibility, reliability, and unidimensionality.

Two indices are given to judge the reproducibility of the scale. By reproducibility is meant that the pattern of the scores will be known if the final score is known. The first index of reproducibility is the Coefficient of Reproducibility which is a statistic that is calculated using the Guttman method. The coefficients of reproducibility for the two participation, three outcome, and satisfaction subscales range from .88 to .95. The range for the overall scales is .88 to .91. These are not extremely high scores, since it has been shown that even randomly generated data will often produce coefficients of .90 (Burns, 1973).

The Green index gives an approximation of the Guttman scale. This statistic is considerably lower than the coefficients of reproducibility, ranging from .24 to .53 for subscales, and .20 to .31 for the overall scales. Burns (1973) tested 105 scales using Green's technique and reported the results. According to his results, a score

of .20 would score at about the 45th percentile of those scales. The highest score of .53, however, would score in the 93rd percentile.

Although these two indices of reproducibility are not extremely high, they are acceptable for the type of scales which are being produced. This is because participation on one item does not necessarily infer that participation will occur on all items after it, and the same is true for outcomes and satisfaction. It is likely that these types of scales do not lend themselves well to this type of test.

A second requirement of a scale is reliability. This is the consistency of the measurement. There are two indices for reliability given by ATSCALE. The first is the Kuder-Richardson 20 (KR 20), which gives the reliability for dichotomous tests. Multilevel responses were dichotomized for the Guttman test, and the KR 20 gives the reliability on the basis of this dichotomization. Cronbach's Alpha is the reliability for tests with items that have multilevel responses. The level of reliability which is deemed acceptable varies, and is dependent on the task for which the scale is being used.

The ranges for the KR20 are .46 to .86 for subscales and .61 to .82 for the scales. The "Changes in Products and Processes" subscale is the most reliable at .86, and the SATISFACTION scale has a satisfactory reliability of .66. When dichotomized, the other subscales are not overly reliable. The overall scales, however, all have satisfactory reliabilities, i.e., greater than .60.

When the multilevel responses were considered, using Cronbach's alpha, the reliabilities of the "Changes in Research" subscale and "Satisfaction" subscales improved, bringing them to an even more

satisfactory level of reliability. The "Individual Participation" and the "Personnel Exchange" subscale have the same alpha score as KR 20, since all the items are dichotomous, and the "Company Participation" subscale dropped very slightly when the single multilevel item was considered with the dichotomous items. The overall scales had satisfactory reliabilities, with alpha being above .60 for all the scales.

The inferred average inter-item correlation is useful to compare reliabilities across scales. A derivation of Spearman-Brown's formula is applied to each of the reliabilities, and from these reliabilities, an inferred average interitem correlation for the scale is obtained (Burns, 1973). These statistics ranged from .11 for the "Company Participation" subscale to .45 for the "Changes in Products and Processes" outcome subscale.

The final requirement of a scale is that it is unidimensional. Three ways of determining unidimensionality are given by ATSCALE. The first method is by examining the corrected item-total correlations. A second way of determining unidimensionality is by Lawley's chi square test. Finally, the Wolins index is given which is not sensitive to sample size, and therefore, probably the best indicator of whether a scale is unidimensional.

A minimum requirement of unidimensionality is that all the items correlate positively with the total score. The corrected item-total correlations given by ATSCALE removes the self-correlation by removing the item being correlated from the total score. These correlations are all positive, albeit rather low in certain cases.

Lawley's chi square, if not significant, is an indication that the scale is unidimensional. This test is sensitive to sample size, however, and when the sample is sufficiently large, even small differences will cause the chi square to be significant. The sample for these scale statistics, however, was 99 which is not an extremely large group. Only the two participation subscales were non-significant, and this suggests that they are single-factored. As for the other subscales and all of the scales, their unidimensionality is thrown into question.

The Wolins index for all the subscales and scales are satisfactory. They range from .76 to .89, but, except for the "Personnel Exchange" subscale and the OUTCOME scale, all of the scores are above .80. It is suggested that a value of .75 should be the lower bounds of acceptable unidimensionality. On the basis of these scores, therefore, and the positive correlations in the corrected item-total correlations, it has been concluded that these scales may be considered single-factored.

In summary, the minimum requirements of a scale are reproducibility, reliability, and unidimensionality. The results produced by the ATSCALE program indicate that the scores for the tests for reproducibility are not very high, however, they are acceptable for these types of scales. This is because it is not expected that a certain type of participation, outcomes, or satisfaction will necessarily precede any of the other types, that is, there is not a hierarchy of participation, outcomes, or satisfaction. The reliabilities of the scales and subscales are satisfactory. While these reliabilities are not extremely high, they are reasonable for the uses

to which the scales will be put. It must be noted, however, that the multiple regression procedures will consider the scales perfectly reliable, and some of the effect may be masked by the unreliability. Unidimensionality, which is the third minimum requirement of a scale, has several tests in the ATSCALE program. The items all correlate positively with the total score, and this is necessary, but not sufficient, to determine single-factoredness. Lawley's chi square statistic is nonsignificant for "Company Participation" and "Individual Participation". This suggests that these two subscales are unidimensional. The other scales and subscales are highly significant, shedding some doubt as to their unidimensionality. Finally, the Wolins indices, which may provide the most reliable indicators of single-factoredness, are all within the acceptable range with the majority of scores above .80. Based on the non-negative correlations and the Wolins scores, the scales have been accepted as being unidimensional. Analysis of the scales and subscales has shown them to be acceptable measures for participation, outcomes, and satisfaction.

Validity is the extent to which the scale measures the construct which it was intended to measure. The only type of validity for these scales which can be established is face validity. By examining the items in the scale, it is obvious that they are appropriate to give a measure of the amount of participation, outcomes and satisfaction. Since at this time, there is no other quantified criterion with which to compare these variables, predictive or concurrent criterion validity cannot be established. Since the relationships among these variables

have not yet been established for interorganizational groups, construct validity cannot be determined.

Relationships among Scales, N=99

Although the entire hypothesis is not supported by these data, there is some evidence to suggest that at least some parts of the hypothesized relationships do exist. The statistical tests which were conducted were Pearson's correlations, two-way analysis of variance, and multiple regression. The following are the conclusions reached by analyzing the test results for the group of 99 respondents.

When this group was examined, a significant correlation was found between "Outcomes in Research" and overall SATISFACTION. This correlation was .35, significant at < .01. This correlation confirms, to a certain degree, the hypothesis that greater outcomes will result in greater satisfaction. A correlation of this magnitude, however, only explains 12% of the variance. "Changes in Research" may not account for a greater amount of the variance simply because some of the centers involved may be in the early years of existence, and research results may not yet be available. Therefore, respondents may exhibit higher levels of satisfaction based on their expectations or the progress of the research, even though they have not experienced any actual outcomes as a result.

Another interesting feature of the Pearson Correlation Coefficient Matrix found in Table 6A of the Results Section is relationship between "Changes in Products and Processes" and SATISFACTION. The correlation of -.02 shows almost no relationship exists between these

two variables. As mentioned previously, however, the scattergram of the correlation between these two variables shows that the respondents who have experienced no effect in this subscale vary greatly in their level of satisfaction. These respondents also number more than half of the entire group, that is, 58.

There are several reasons why this group of 58, who have experienced no effect in this particular area, may still be highly satisfied. First, the centers, themselves, may not provide research which can be utilized for improving products and processes within a company, and companies would have no expectations in this area. Second, the company may not have joined the center for the purpose of improving processes and products, but may merely be interested in keeping abreast of the research in the area or finding qualified personnel among the students involved with the center. If these objectives are met, the company will be satisfied. Finally, as mentioned earlier, some centers may be at the early stages in their development, and research results may not yet be available, although the sponsors are still highly satisfied since they are anticipating results at some future time.

The remaining 41 respondents, who have reported at least some effect, do seem to exhibit some relationship between the amount of outcome and satisfaction and have been examined in greater detail as will be discussed in the following section.

The zero-order correlations for N=99 provide little to support the hypotheses about participation affecting outcomes or satisfaction. There are no significant correlations between participation and either of these two variables. Part of the problem with these results lies in

the unreliability of the scales. Further, it is not known if there are other types of participation which were not tapped by the items in the questionnaires filled out by the sponsors. These two problem areas cannot be distinguished from the possibility that participation truly does not affect either the number of perceived outcomes or the amount of satisfaction of the sponsors.

When the overall scales were correlated, the resulting Pearson's Correlation Coefficient Matrix, Table 9B, shows no areas of significance. The coefficients range from .03 between "Personnel Exchange" and overall OUTCOMES to .18 between overall PARTICIPATION and overall OUTCOMES. Overall PARTICIPATION correlates with general SATISFACTION at .15, and overall OUTCOMES correlates at .16.

The fact that overall OUTCOMES is not significantly related to SATISFACTION when the overall scales are analyzed may be due, in part, to the composition of the scale. The overall OUTCOME scale is comprised of the "Changes in Research" subscale which has a range of 5 to 16, and the "Changes in Products and Processes" subscale which has a range of 8 to 24. With a greater range, the "Changes in Products and Processes" subscale is weighted more heavily in the overall scale, and the overall OUTCOME scale is more affected by it than by the "Changes in Research" subscale. As noted earlier, there is almost no correlation between the "Products and Processes" outcome subscale and SATISFACTION, and there is a significant correlation between "Changes in Research" and SATISFACTION. When these two scales are combined, a nonsignificant correlation results.

In order to do a two-way analysis of variance, a 2 X 2 matrix was formed with high and low levels of participation and outcome. The four cells include respondents with low participation/low outcomes, low participation/high outcomes, high participation/low outcomes, and high participation/high outcomes. All the mean scores for satisfaction for these groups are within 1 point, from 16.24 to 17.22. The lowest mean is the group who have low participation and low outcomes at 16.24. Next, at 16.91, is the group with low participation and high outcomes. At 17.15, the next highest group is the high participation, high outcome group, and finally, the most highly satisfied group is the high participation, low outcome group at 17.22.

The two-way analysis of variance shows that there is no significance among the main effects or the interaction of participation and outcomes among the groups. This analysis, however, sacrificed a great deal of information when the participation and outcome scales were dichotomized rather than using the original continuous scales. Therefore, in order to take advantage of the interval scale, multiple regression was performed.

When SATISFACTION was regressed on combinations of the participation and outcome subscales, the multiple regression analysis shows that participation did little to predict changes in the level of satisfaction. The only subscale which does show a significant R square change is "Changes in Research" which had an R square change of .11. The multiple R for the combination of this variable with "Company Participation" is .37, which is a squared multiple correlation of .13. For the combination of "Individual Participation" with "Changes in

Research", the multiple R is .35, and the squared multiple correlation is .12. This means that, at best, a simple combination of either of the participation subscales with either of the three outcome subscales explains only 13% of the variance in the SATISFACTION variable.

A similar result is found when all of the subscales are entered into the regression equation as independent variables. The only significant R square change is "Changes in Research" at .11. The multiple R for the entire equation is .41, which explains approximately 17% of the variance in SATISFACTION. It becomes obvious that adding all the subscales to the equation does little to increase the ability to predict the SATISFACTION variable.

When the overall scales are used as independent variables and SATISFACTION is regressed on them, there are no areas of significance. The multiple R is .22 which only explains 4% of the variance.

It would appear, that for this entire group, changes involving research is the best predictor of satisfaction among the corporate sponsors. Participation by departments and top management within the company and participation by the corporate sponsor representative does not seem to be related to levels of outcome or satisfaction for this group. Personnel exchange does not appear to be significantly related to satisfaction. Outcomes involving improvements in products and processes does not show any apparent relationship, however, for the reasons mentioned earlier, a group of respondents who experienced no effect in this area vary greatly in their level of satisfaction. For those respondents who experienced at least some effect in this area, it

appears that some relationship does exist between this area of outcome and satisfaction. To further explore this relationship, this group of 41 respondents was examined separately using the same statistical tests performed on the entire group.

Relationships among Scales, N=41

The Pearson Correlation Coefficient Matrix for the group of 41 respondents exhibits a rather high correlation between "Outcomes in Research" and SATISFACTION at .51. Further, a significant correlation now exists between "Changes in Products and Processes" and SATISFACTION at .36. These areas of significance seem to confirm the hypothesis that the level of outcomes is related to the level of satisfaction. The only outcome which does not correlate significantly with satisfaction is the "Personnel Exchange" subscale. This subscale has a nonsignificant -.11 correlation for this subgroup of respondents; this correlation changed from a positive .11 when all the respondents were considered. This change from a positive to a negative correlation may be due to the expectations of the groups. It is possible that several of the respondents in the entire group sought Center membership in the hopes of acquiring trained personnel as well as benefiting from the research results. These same respondents may not have been concerned about improvements in products and processes. For those who experienced at least some affect in products and process outcomes, the expectations may be quite different. Clearly, improvements in products and processes are pertinent to their needs, and personnel exchange may not have been one of the major goals when joining in the center.

A significant correlation is also noted between "Company Participation" and overall SATISFACTION. This lends some credence to the hypothesis that levels of participation will affect levels of satisfaction. While there is a correlation with SATISFACTION, "Company Participation" does not correlate significantly with any of the outcome subscales. The conclusion that can be reached is that participation does not directly affect outcomes. This is contrary to one of the original hypotheses that greater participation will result in a greater number of outcomes.

The correlations among the overall scales exhibit only one area of significance, and that is a .51 correlation between overall OUTCOMES and overall SATISFACTION, significant at < .01 level. This is a substantial correlation which is not entirely surprising with this group. It must be considered that this group, who have already experienced some effects in products and processes, must belong to a center that has been in operation long enough to produce useful research results, and further, these results are being or have already been implemented within the company. This group, then, most likely belong to the more established centers, and have been able to determine whether or not the research results are relevant to their needs. With this group, expectations for research results plays a lesser role than the usefulness of the results themselves. Therefore, it stands to reason that the number of outcomes would be more likely to affect how satisfied they are with the centers. This, interestingly, may point to the fact that satisfaction levels may be related to different variables dependent upon the age or development of the centers.

The correlation of overall PARTICIPATION with SATISFACTION is not significant at the .05 level which requires a correlation of .304. The correlation which occurs is .29, which is very close to being significant. Although no conclusions can be made about overall PARTICIPATION and SATISFACTION with this group, it was noted earlier that at least "Company Participation" is significantly related to SATISFACTION for this subgroup of respondents. The other correlations between overall PARTICIPATION and overall OUTCOMES, and between "Personnel Exchange" and any of the three scales are not significant.

Another confirmation of the relationship between overall OUTCOMES and general SATISFACTION is given by the results of the two-way analysis of variance. Once again, the PARTICIPATION and OUTCOME scales were divided at their median to render four cells with high and low levels of participation and high and low levels of outcomes. The results of this test show that there is a significant main effect over the outcome variable, that is, the mean of the low outcome group differs significantly from the mean of the high outcome group. The means of the high and low participation groups do not differ significantly, and there is no significant interaction between the variables.

It is obvious from examining the 2 X 2 matrix provided in Table 13A that the means of the high outcome group are higher than the means of the low outcome group. To examine more directly the direction of the relationship, however, multiple regression analysis was performed.

First, combinations of the participation and outcome subscales were used as independent variables, and overall SATISFACTION was the

dependent variable. The subscales provide greater predictive ability for this subgroup of respondents than they do for the entire group. "Company Participation" now exhibits a .11 R square change. When it is combined with "Changes in Research", which has a .19 R square change, the squared multiple correlation is .30. This combination of subscales, then, explains approximately 30% of the variance in the SATISFACTION variable, which is substantially more than is explained for the entire group.

Also significant, is the regression of SATISFACTION on the combination of "Company Participation" and "Changes in Products and Processes". Each of these variables has a R square change of .11, and the multiple R is .47, which yields a squared multiple correlation of .22.

The "Individual Participation" variable does not explain a significant amount of the variance of the SATISFACTION variable. When the outcome variables are combined with this "Individual Participation" variable, therefore, the "Changes in Research" and "Changes in Products and Processes" remain significant predictors, but the squared multiple correlations drop from the earlier ones since "Individual Participation" does not add to the combination's ability to predict. The "Personnel Exchange" subscale explains almost none of the variance of general SATISFACTION.

When all of the subscales are entered into the regression equation in the order of "Company Participation", "Individual Participation", "Changes in Research", "Changes in Products and Processes", and "Personnel Exchange", the squared multiple correlation is .36. Most of

the predictability was due to "Company Participation" and "Changes in Research". These were the only two significant predictors, with "Changes in Products and Processes" having only a .04 R square change.

The overall scales yield a multiple R of .58 with a squared multiple correlation of .33. The OUTCOME scale is significant with an R square change of .23. The PARTICIPATION scale and "Personnel Exchange" subscale do not explain significant amounts of the variance in SATISFACTION, but they do add somewhat to the predictive ability of the entire equation.

These results demonstrate that for the 41 respondents who have experienced some effect in product and process outcomes, "Company Participation" is related to satisfaction, but there does not seem to be any connection between the individual respondent's participation and general satisfaction. The hypothesized relationship between participation and outcomes is not borne out by these results.

The relationship between "Changes in Research" and SATISFACTION appears to be somewhat stronger among this subgroup of respondents. There is also a significant relationship noted between "Changes in Products and Processes" and SATISFACTION. Since centers must be in existence for a fair amount of time before research results could be presented and then utilized by the sponsor, the age of the center may be a factor in determining the strength of the relationship between outcomes and satisfaction. "Personnel Exchange" does not seem to affect satisfaction levels, and this may be due to the fact that for sponsors who are benefiting from outcomes involving products and processes, personnel exchange may not be a high priority.

Summary

The results show little support for the hypothesis that the level of participation is related to the level of outcomes realized by a sponsor. There is some support to indicate that company participation and satisfaction are related for the group of sponsors who are likely to have an effect in product and process improvement. Outcomes do seem to have some relationship to satisfaction. There are significant relationships to support the fact that outcomes involving research are related to satisfaction in all of the performed tests. For those who have had at least some effect in product and process outcomes, and presumably, this group has expectations in this area, the number of outcomes is positively related to satisfaction levels. Personnel exchange does not seem to be significantly related to levels of satisfaction.

However, with only 33% of the variance explained by participation and outcomes for the N=41 group, and much less for the N=99 group, it must be concluded that, as it stands, these variables are not the only predictors of satisfaction among the sponsors. This may have occurred for several reasons. First, the scales themselves are not extremely reliable. Perhaps more reliable scales would show a greater relationship. Also, there are other ways in which participation occurs and outcomes are realized that are not covered in the instrument used for the study. There was also a great deal of missing data, which may have caused erroneous assumptions to be made. Finally, there are many reasons why a sponsor may be satisfied with a center, and these factors may account for some of the variance of the satisfaction variable.

Problems with Present Evaluation

As mentioned above, this study had to deal with a great deal of missing data. Some of the assumptions that were made regarding these data may have influenced the result.

Another area which could have been explored for this study would be the expectations of the particular sponsors. If several sponsors had expectations regarding research and/or personnel exchange rather than effects involving improvements in product and process, this group could have been isolated and the outcomes scale could have placed a greater emphasis on the subscales which represent their particular expectations. The same could be done for those sponsors who are expecting improvements in products and processes. This would present a better picture of the relationship between outcomes and satisfaction.

While no significant relationships were found between participation and outcomes, and only inconsistent ones between participation and satisfaction, the question arises as to whether there has been an accounting for all types of participation. For instance, other evidence could have been collected, such as the number of contacts the sponsor has had with the center or its researchers, and the amount of time spent on consulting with the center on research projects. Perhaps, more complete information on this participation would have had some effect on the relationships which were studied.

Finally, a way must be found to deal with the unreliability of the scales. One way of doing this is to use the hypothesized model to do further analysis with causal modeling using the LISREL program. This

program provides a method of examining whether the observed data fits the hypothesized model. If the reliability of the scales are known, this can be added to the equation, and a better picture of the true relationships may be available if the data do, indeed, fit the model.

Suggested Improvements

One simple way to improve the study of the relationships between participation, outcomes, and satisfaction is to improve the instrument in order to get more relevant and precise information from the sponsors about these variables. For example, questions could be posed to the sponsors asking them, point blank, what their expectations are and whether or not they are being met. Another area which would provide a great deal of information would be the number of research projects which were actually utilized by the company, and how and why the research results were implemented. A final question could focus on the reasons for the respondent's particular level of satisfaction or dissatisfaction. This information, as a supplement to the present study, would offer some explanations for several of the relationships or lack of relationships.

Another way to improve the project would be to use the constructed scales on a yearly basis to observe trends among the centers. This would provide important information to the center directors, themselves, as well as to the funding institution about the 'health' of the center or centers. Further, it would also provide a confirmation of the validity of the results from this present study, that is, whether the relationships found in the present study hold up under further analysis.

Finally, the best test of whether levels of satisfaction are related to the longevity of a center is to do a retrospective study of the centers. This study would examine the attributes of centers which have continued to survive after NSF funds have been withdrawn and those which have not. To do this, one would look at a number of centers who have completed the five year NSF funding period to determine whether or not the centers which continue to exist did, in fact, demonstrate higher levels of satisfaction among the corporate sponsors. On the other hand, were those which were terminated because of lack of corporate funds demonstrating lower levels of satisfaction? This further study would provide the best indication of the importance of satisfaction levels in determining whether centers will continue to be in operation after NSF funds have been withdrawn.

What Can Be Learned?

It is hoped that the information provided by the present study will add to the theoretical body of knowledge regarding interorganizational processes, especially in the area of technology transfer. The findings of this study can also be useful to center directors, the National Science Foundation, and to the evaluation community, in general.

The present study provides some insights into the transfer of technology among organizations. It does this by providing an initial exploration into the factors that affect satisfaction among the receivers of technology transferred between organizations. This is important because there is little in the literature on

interorganizational processes to support the hypotheses about participation and outcomes leading to satisfaction.

The conclusions of this study show that it is important that transferred research findings result in changes in R&D laboratories within the receiving company, and/or in new research projects. When this occurs, the receivers of technology are more likely to be satisfied with the partnership. Also, among a certain group of receivers whose interests lie in changing products and/or processes through transferred technology, greater change in these areas leads to greater satisfaction. Among companies with these objectives, participation of several functional groups within the company in interorganizational activities also seems to increase satisfaction.

While this information adds to what is already known about technology transfer, this study is only a first step which raises many more questions than are answered. Specifically, there are some suggestions that the variables of participation, outcomes, and satisfaction should be measured more reliably, and questions can also be raised as to how these variables are causally related to one another.

Center directors would find the subscale scores used in this study particularly interesting to monitor the progress of their center. For instance, the individual participation subscale could show them the effects of their administrative procedures on the level of participation among the corporate sponsor representatives. Lower levels of participation or outcomes in a specific year may be a 'red flag' to center personnel to re-examine their agenda and get more in touch with their sponsors and their research needs. In other words, these subscale

scores could provide a useful measure for determining the level of sponsor participation and the success of the research objectives of the center. Also, the scales would provide, on a yearly basis, the level of satisfaction among their corporate sponsor group. This information about participation, outcomes and satisfaction, used together, can offer some guidance to the director as to where any problems might lie. For instance, if participation and outcomes levels appear to be high, but the satisfaction score is low, there may be other internal problems which should be examined and addressed.

Further, the results of this study show that changes in research seems to be an area which is highly related to satisfaction of the sponsors. This subscale contained items such as new research projects being implemented in sponsoring companies, and changes in the topics, methods, and methods of evaluation in the current R&D projects within the company. This puts some very specific information into the hands of the director as to where to concentrate the efforts of the researchers. Exploring new topics and using new methods is a source of important information to the representatives who, in turn, transfer this information to the company researchers in R&D. The study also indicates that company participation is related to satisfaction scores, and faculty researchers should be encouraged to include many functional groups within the company as resources for input into research designs.

The National Science Foundation could use the subscale scores to monitor the centers. If a center is experiencing problems in a particular area, the director can be put in touch with other center

directors who have experienced similar problems in the hopes that a solution could be found. The information about the levels of participation, outcome, and satisfaction may also demonstrate that certain administrative policies in the centers result in higher or lower scores on the subscales.

The results of this study show that changes in research in the R&D projects within the company are related to higher levels of satisfaction. It would be particularly useful, therefore, to encourage centers to explore new topics, i.e., not only concentrate on applied problems in industry, and to use innovative designs and methods of evaluation. With this information, NSF could provide some guidance to new or developing centers.

Finally, this study provides some useful information to the evaluation community. The use of scales in research provides a method to operationalize constructs. Scales are more reliable than single items; they also contain a greater amount of the true score variance of a construct compared to the amount of error. Further, programs such as ATSCALE provide useful statistics to gauge the robustness of the scale by looking at the levels of reproducibility, reliability, and unidimensionality.

This study, which merely examines the relationships among the variables, also lays the basis for the examination of causal relationships, and suggests further study through the use of causal modeling techniques.

As always, an original research project in any given area offers the evaluation community one new avenue of approach that can lead to the discovery of a previously unexplored social phenomenon.

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APPENDIX 1

1:9/85

1

ID Code #_ _ _ _ _ _
(1-6 line 1)

.....

INDUSTRIAL SPONSOR QUESTIONNAIRE

In order to understand the relationship of the Center with its industrial sponsors, it would be useful to have some background about the people who work with the Center, such as yourself. Questions 1 to 9 are designed to give the assessment team some data about you, your experience, and your job within the firm.

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1. How many years have you spent with your company? _____ ... ... (7-8)

2. How many years have you spent in research and development with your company? _____ ... ... (9-10)

3. How many years have you spent in industry in general? _____ ... ... (11-12)

4. How many years have you spent in research and development in industry? _____ ... ... (13-14)

5. To whom do you report in your company? (title or position only)

---

6. How many organizational levels are there between you and the chief executive officer? _____ ... ... (15-16)

7. How many people report directly to you? _____ ... ... (17-19)

How many report to you through subordinates? _____ ... ... (20-23)

8. What is the highest degree you have received? _____ ... ... (24-25)

In what field? _____ ... ... (26-27)

9. Do you have a degree from or have you taken course work at the University?

_____ Yes _____ No ... (28)

We are also concerned with the decision making and logistics associated with your company's involvement with the Center. We know that in general the scope of discussion in companies about Center participation has varied widely; so has the amount of prior contact with university personnel. Items 10 to 20 are intended to help us understand the early formation of Center programs.

10. Prior to participation of your company in the Center, was your company involved in any of the following activities with university personnel now associated with the Center? (Check all that apply)

____ Use of faculty as consultants ... (29)

____ Contract research products ... (30)

____ General support of faculty research ... (31)

____ Support of student thesis research ... (32)

____ Faculty exchange ... (33)

____ Student exchange ... (34)

____ Other (please specify) ... (35)

11. Prior to participation of your company in the Center, how frequently did you personally have contact with personnel now affiliated with the Center?

____ Several times per week

____ Several times per month

____ Several times per year

____ Rarely or never ... (36)

12. Were you involved in any of the following activities prior to the establishment of the Center? (Check all that apply)

____ Recruitment of new member companies ... (37)

____ Organizing meetings ... (38)

____ Proposal writing ... (39)

____ Planning ... (40)

____ Building support within the university ... (41)

____ Other (please specify) ... (42)

_____

13. What is the approximate total annual cost of your company's participation in the Center in addition to the yearly fee?

Travel expenditures $_____ ... ... (43-45)

Staff time $_____ ... ... (46-48)

Space $_____ ... ... (49-51)

Additional direct or indirect contributions (please specify) $_____ ... ... (52-54)

_____

_____

14. During the past year what functional groups in your company worked directly with the Center?

	Regularly	Occasionally	Not at all	
Central R&D staff	____	____	____	... (55)
Divisional R&D staffs	____	____	____	... (56)
Production staff	____	____	____	... (57)
Marketing staff	____	____	____	... (58)
Engineering/technical staff	____	____	____	... (59)
Corporate planning staff	____	____	____	... (60)
Other _____	____	____	____	... (61)

15a. How many organizational levels at your firm had to give explicit approval to your participation in the Center?

____ ... (62)

15b. What was the highest level that had to give approval?

____ Department

Division

____ Central

____ Other

... (63)

16. How many individuals at your level in your company had to concur with the decision to participate in the Center?

____ ... ... (64-65)

17. To what extent is your top management involved with the activities of the Center?

____ Completely

____ Considerably

____ Somewhat

____ Not at all ... (66)

18. During the past year approximately how many people in your company have requested information from you concerning specific activities or projects of the Center?

____ ... ... (67-68)

19a. Approximately what percentage of these information requests can be classified as technical in nature? ____% ... ... (69-71)

19b. Approximately what percentage concerns administrative or operational issues of the Center? ____% ... ... (72-74)

20. Do you currently take an active role in any of the following activities of the Center? (Check all that apply)

____ Recruitment of new member companies ... (75)

____ Organizing meetings ... (76)

____ Proposal writing ... (77)

____ Planning ... (78)

____ Building support within the university ... (79)

____ Other (please specify) ... (80)

_____

A primary concern of this assessment is the various results and benefits that have accrued to companies from participation in the Center. Please be as objective and candid as possible, since in the long run it will be to the Center's advantage to understand its strengths and limitations fully. Questions 21 to 35 focus on outcomes, results, and potential benefits.

ID Code # _ _ _ _ _ _
(1-6 line 2)

21. During the past year how would you rate the overall research program in the Center compared to similar research programs in other U.S. universities?

____ Top 2%

____ Top 10%

____ Above average

____ Below average

____ Not comparable, because...

_____ ...
(7)

_____

22. During the past year how satisfied were you with the following features of the Center?

	Completely Satisfied	A Great Deal Satisfied	Somewhat Satisfied	Not at all Satisfied	
Technical quality of the research	____	____	____	____	... (8)
Communications between Center staff and your company	____	____	____	____	... (9)
Center administrative practices	____	____	____	____	... (10)
Responsiveness of the Center to industry needs	____	____	____	____	... (11)

23. Are there any particular features of the Center operations and results with which you are especially satisfied?

... ...
(12-13)

24. Are there any particular features of the Center operations and results with which you are dissatisfied?

... ...
(14-15)

25. How important to you are the following goals and outcomes of the Center?

	Extremely Important	Considerably Important	Somewhat Important	Not at all Important	
General expansion of knowledge in this technical area	____	____	____	____	... (16)
Enhancement of graduate student technical training	____	____	____	____	... (17)
Enhancement of graduate students' understanding of industry	____	____	____	____	... (18)
Redirection of university research toward industrial problems	____	____	____	____	... (19)
Enhancement of quality of industrial research	____	____	____	____	... (20)
Development of new company research projects	____	____	____	____	... (21)
Development of patentable products	____	____	____	____	... (22)
Development of commercialized products	____	____	____	____	... (23)

26. Do you think that the Center has established realistic goals and objectives?

____ Yes

____ No (Explain)

____ Maybe (Explain)

_____

_____

_____ ...
(24)

27. How likely is it that your company will realize tangible benefits in the following areas as a result of your participation in the Center?

	Almost Certain	Pretty Likely	Somewhat Likely	Scarcely Likely	
Better personnel recruitment	____	____	____	____	... (25)
Improved research projects in your company	____	____	____	____	... (26)
Patentable products	____	____	____	____	... (27)
Commercialized products	____	____	____	____	... (28)

28. During the past year, approximately how many new research projects have been stimulated in your research laboratories by the Center activities? ____ ... ... (29-30)

How much is this in terms of research dollars? ____ ... ... (31-33)

What percentage is this of your total R&D budget? ____% ... ... (34-35)

In terms of person-years of full-time-equivalent staff? ____ ... ... (36-37)

29. During the past year has participation in the Center activities stimulated other outside research contracts with faculty or another laboratory?

____ Yes. If so, approximately how many research dollars? _____ ... (38)

____ No ... ... (39-41)

____ Don't know

30. During the past year to what extent has the research conducted at the Center caused changes in the R&D projects in your company?

	A lot	Some	A little	Hardly Any	
Research topics and issues	_____	_____	_____	_____	... (42)
Research methods and procedures used	_____	_____	_____	_____	... (43)
Criteria and methods used to evaluate research products	_____	_____	_____	_____	... (44)

31. If the Center program has caused some changes in the R&D projects you conduct, what specifically are these changes?

... ... (45-46)

32. During the past year has your participation in the Center had any effect on the following in your company?

	No Effect	Moderate Effect	Significant Effect	Not Applicable	
Improvements in products and services	____	____	____	____	... (47)
Changes in warranty and complaints in view of improvements in products	____	____	____	____	... (48)
New products developed due to related efforts	____	____	____	____	... (49)
Changes in cost of products to users (price changes or decreased product maintenance)	____	____	____	____	... (50)
Reduction of production costs	____	____	____	____	... (51)
Improvement in processes and methods of production	____	____	____	____	... (52)
Increased uniformity of products	____	____	____	____	... (53)
Improved product or process design	____	____	____	____	... (54)
Improved capability to deal with government regulations	____	____	____	____	... (55)
Improved capability to cooperate with outside scientists	____	____	____	____	... (56)

33. During the past year how many students trained in the Center research projects have been interviewed for possible employment in your company? _____ ... ... (57-58)

How many have actually been hired? _____ ... ... (59-60)

34. During the past year how many university scientists from the Center have spent time working on-site in your company's labs? _____ ... ... (61-62)

How many scientists from your company have spent time working on-site at the Center? _____ ... ... (63-64)

35. To what extent are you generally satisfied with the operations and activities of the Center?

____ Completely satisfied

____ Considerably satisfied

____ Somewhat satisfied

____ Not at all satisfied ... (65)

38. Please make any additional comments you wish.

THANK YOU FOR YOUR COOPERATION!
Results in an aggregated form will be made available to all respondents to this questionnaire.

VITA

Mary Jean A. Russo, the daughter of Francis and Theresa Smith, is a native of Bethlehem, and attended parochial schools until her high school graduation in 1969. For six years, she was employed as a medical secretary for a local physician. While in that position, she attended college on a part-time basis.

She received an Associates Degree from Northampton County Area Community College, Bethlehem, in 1980. In 1984, she graduated summa cum laude from Moravian College, Bethlehem, with a Bachelors Degree in Social Work. In June of 1985, she was inducted into the Delta Omicron chapter, Alpha Sigma Lambda national honor society for continuing higher education.

During her years at Moravian, she also did volunteer work, visiting with the elderly, at Holy Family Manor in Bethlehem. From July of 1983 until September of 1984, she was employed on a part-time basis at Leader Nursing and Rehabilitation Center as an Activities Assistant.

In September, 1984, she entered the Master's program in Social Relations at Lehigh University. While at Lehigh, she was a graduate teaching assistant in 1985 and 1986. She also served as a graduate research assistant at the Center for Social Research from 1986 until present. In this position, she assisted in the National Science Foundation's evaluation of two University/Industry Cooperative Research Centers at Lehigh University.

She was married in 1976 to Donald P. Russo, an attorney, who is presently employed as Corporate Counsel for Merchants Bancorp.