

ABSTRACT

COBERLY, BETH MARIE. Faculty Satisfaction and Organizational Commitment with Industry-University Research Centers. (Under the direction of Denis O. Gray)

Faculty are an important part of cooperative research centers. However, their decision to become involved in a center is entirely voluntary. A center's success is dependent on both the recruitment and retention of top-notch faculty. Knowing what contributes to a faculty member's satisfaction, commitment, and ultimately decision to remain in the organization should be a high priority for center management. The purpose of this study was to examine the concepts of satisfaction and organizational commitment as they pertain to faculty involved in industry-university research centers. A model, which included the variables of intrinsic rewards, extrinsic rewards, satisfaction, commitment, and retention cognitions, was proposed. Data were collected from faculty at industry-university research centers nationwide via an Internet survey. Results showed support for the proposed model. In particular, the model shows that satisfaction is a significant predictor of commitment. Both intrinsic and extrinsic rewards were significant predictors of satisfaction. Intrinsic rewards also had a direct effect on commitment. Both satisfaction and commitment have a significant direct effect on retention cognitions. Implications of the model results for centers are discussed.

**FACULTY SATISFACTION AND ORGANIZATIONAL COMMITMENT WITH
INDUSTRY-UNIVERSITY RESEARCH CENTERS**

by
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DEDICATION

This dissertation is dedicated to my grandfathers, Chester Wiater and Adelard Meagher who are sharing the joy of this moment with me in spirit.

BIOGRAPHY

Beth Marie Meagher was born on July 4, 1977 in Springfield, Massachusetts. After graduating from Agawam High School in 1995, she attended Smith College in Northampton, Massachusetts. She graduated in May of 1999 with a bachelor's degree in Psychology. In August of 1999, she moved to Raleigh, North Carolina to begin graduate studies in psychology at North Carolina State University. During her graduate career, she was a project manager for the National Science Foundation Industry-University Cooperative Research Center's Program Evaluation Project under the direction of Dr. Denis O. Gray. She received her Master's degree in August of 2002, with a thesis that focused upon the outcomes received by faculty involved in industry-university research centers. Beth currently works as a research and program evaluation specialist with the North Carolina Division of Vocational Rehabilitation. In July of 2003, she married Theodore Hamilton Coberly, a former Captain in the United States Army. They reside in Zebulon, North Carolina.

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LITERATURE REVIEW

Introduction

This study focuses on faculty involvement with industry-university research centers. More specifically the focus is on the satisfaction and organizational commitment of faculty to these centers. The dissertation is broken up into four sections. The first section is the literature review, which discusses the literatures of industry university collaboration (particularly as it pertains to faculty), rewards, job satisfaction, and organizational commitment. These literatures are tied together into an overall model of satisfaction and organizational commitment to the research center. The next section, methods, describes the specific measures and procedures used to collect data from faculty at industry-university centers. The results section presents the results of the model analysis. Finally, the discussion section focuses on drawing the results of the model together with previous research. It also includes a discussion of policy implications based on the results of the analysis of the model.

Research and Development in US Universities

The United States spends an enormous amount of money on research and development (R&D). A great deal of this research takes place in institutions of higher education. In 2000, universities conducted approximately 43% of all basic research in the US. In terms of dollars spent, approximately \$30 billion dollars was provided by the federal government, the university, state and local government, industry, and other sources towards research at universities and other academic institutions. Of this total amount, industry provided \$2.3 billion dollars, towards university research and development. This amounts to 7.7% of the total funding for university research, its highest percentage of funding since the 1950's. While this amount seems small in comparison to money spent by other sources, the

amount of industry funding has been growing at the fastest rate among all sources of funds to academic institutions. In 1973, \$84 million was spent by industry on university research. In 2000 industry spent a little over 27 times that amount (National Science Board, 2002).

A closer look shows that industry provides a significant portion of research funding in specific disciplines. A national survey of engineering faculty found that 17% of all funding to individual faculty for university based research and development in engineering for 1993 came from industry. Seventy-nine percent of the engineering faculty surveyed reported that they either currently receive or had received in the past, industry funding for their research. The same percentage of faculty also wanted to see more industry involvement in academic research (Strickland, Kannankutty, and Morgan, 1996).

One of the reasons for the increase in industry funding is the changing nature of business and R&D in the United States. Industry is seeking R&D resources outside of the company because of economic stress, downsizing, and the constant broadening scope of research in many fields. At the same time, the sources of funding for university research have changed over the last few decades. While the government has historically provided the majority of research funds, this percentage has decreased. In 2000, the government provided 58 percent of the total academic research funds, down from a peak of 73 percent in 1966 (National Science Board, 2000). Therefore, university researchers are looking to expand their funding sources, the private sector being one of the possibilities.

Changes in public policy over the last two decades have also helped to promote the research collaboration between industry and university. The reasons behind many of the policy changes, particularly those occurring in the 1980's were due to increased concern about the United State's international competitiveness. Also, there emerged an

“intertwining” of science and technology with the rise of such industries as computers, telecommunications, and biotechnology. Much of the seminal research in these areas was located in universities and government agencies. Thus a need was created for linkages between those organizations that produce new knowledge and those organizations that could transform the knowledge into products and processes that had commercial applications (Feller, 1999).

The changes in public policy began with the Stevenson-Wyler Technology Innovation Act of 1980. The act stated that R&D activities that occurred in the university had a significant impact upon innovations in industry and mandated that Federal Labs actively engage in cooperative research with academia, industry, nonprofits, and local governments. It created several Centers for Industrial Technology, which were affiliated with universities and nonprofit institutions (Feller, 1999). The Bayh-Dole Act, passed in 1980 did three things: it gave universities and non-profit organizations the right to hold property rights for inventions that were the result of federally funded research; it gave government owned and operated laboratories the authority to grant licenses to patents, and it allowed for a reasonable period of time to allow for a patent application to be filed before the knowledge is publicly disseminated. Several other acts were passed over the next two decades, the most recent one being the National Technology Transfer and Advancement Act of 1995. This act clarifies “the intellectual property rights of private sector partners for technologies created in partnership with one of the nation’s federal laboratories” (p. 55) (Rahm, et. al., 2000). These changes in legislation have contributed to an increase in the amount of research collaboration between industry and university (Cohen, Florida, & Goe, 1994).

Industry-University Linkages

There are many types of linkages that industry can make with the university. Informal linkages may consist of faculty consulting, student job placement, and student internships. More formal linkages with the university include contract research, research parks, industrial R&D consortia, and industry-university research centers (Rahm, et. al., 2000). Koester and Gray (1990) provide a more in-depth typology of industry-university linkages. In their typology, industry-university linkage mechanisms vary along three dimensions: primary purpose, organizational formality, and the relationship to the university. The different combinations of these dimensions can have a profound effect on the stage of the innovation process that is affected, the degree of alignment with the goals of the industry and the university, or the size, scope, and complexity of work that is done.

A linkage mechanism can have one of five primary purposes: research, knowledge/technology transfer, product/process development, brokerage liaison, or multipurpose. A linkage mechanism with the purpose of research would create new knowledge by using a method of systematic inquiry. A linkage with the purpose of knowledge/technology transfer would transfer knowledge or technology that already existed by activities such as training or consultation. Product/process development linkages assist with the development and marketing of new products and processes. Brokerage/liaison linkages facilitate the relationship between the industry and university. Finally, multipurpose linkages fulfill more than one of these purposes (Keoster & Gray, 1990).

The second dimension in which linkages can vary is in the degree of organizational formality. Organizational formality can be described as “the extent to which the linkage mechanism possesses the structures, procedures, and infrastructure one associates with well-

defined organizations or organizational units” (p. 18). Standard linkage mechanisms are the most formal and have established goals, administrative staff and leadership hierarchy.

Adaptive linkage mechanisms are similar to standard linkages except they have a more limited administrative and physical infrastructure. Shadow linkage mechanisms generally have no administrative and physical infrastructures and may exist as an organization on paper only. Finally, informal linkage mechanisms have no organizational characteristics.

Examples of this type of linkage are research contracts between a professor and a firm, internship programs, and faculty consulting to firms (Koester & Gray, 1990).

The final dimension is the relationship of the linkage mechanism to the university. Linkage mechanisms that are described as central are part of the organization of the university. They are closely aligned with the norms and goals of the university and have a hierarchical system of control. Cooperative extension programs, which are at many universities, are examples of this type of linkage. Semi-autonomous linkage mechanisms have a higher level of independence from the university. They are usually in charge of determining their own budget, goals, and administrative operations. An example of this type of linkage is the Industry-University Research Center. Finally independent linkage mechanisms are almost completely separate from the university. There is usually an agreement made with the university for the use of building space or other resource. Industrial research parks are an example of an independent linkage mechanism (Koester & Gray, 1990).

Research on Industry-University Linkages

There is a great deal of research that has been done on industry-university linkages. In a review of over 100 studies, Feller (1999) reports an increase in the amount of university

involvement in tech transfer as indicated by licenses and patents. However, he also reports that industry does not get involved with research in the university in order to find a technological breakthrough. Rather, their involvement is to tap into improvements in theories and improved techniques for conducting research, which then can be brought into the industry labs to aid in the creation of new technology. In fact, the major reasons firms become involved in one type of linkage, research centers, are for access to state of the art knowledge, associations with faculty, and access to graduate students.

In a recent survey of research and development managers from the manufacturing industry Cohen, Nelson, and Walsh (2002) asked respondents to consider the impact of research produced by universities and government labs. About one third of the respondents reported that public research was a source of new project ideas. Over one third also indicated that public research aided to the completion of projects. “Public research provides the means to achieve some technological goal, which itself emerges, if not from the firm’s own R&D, then typically either from buyers’ or the firms’ own manufacturing operations (p. 7).” This is done primarily through research findings and instruments and techniques rather than the creation of prototypes by the public sector. In terms of the paths of knowledge flow, the majority of research results are disseminated to industry through publications and reports. Also important are informal exchanges, meetings and conferences, and consulting relationships.

In spite of the large amount of research that has been done on industry-university research collaboration, there is one population in the relationship that has been relatively neglected in research. This population is the university faculty member. Gray (2000) mentions that this oversight is significant given that the possible negative consequences for

faculty involved in this type of collaborative research are frequently mentioned. Lee (1996) also states that more empirical research needs to be done on faculty. Faculty are an important part of the research relationship with industry and knowing more about their participation in the relationship would help to make this type of collaboration more effective overall.

Faculty and Industry-University Collaboration

There is a small body of literature focusing on faculty and industry-university collaboration. In an earlier study, the author did an exhaustive literature search for research articles focused on this topic. Articles were located via databases using key words such as “faculty and industry”, “industry and university”, and “research faculty”. Only research articles that dealt specifically with the faculty side of the industry-university relationship were reviewed. In all, 11 studies were located, published between 1986 and 2002. The following is a summary of the results of that search, for a complete review of this literature, please see Meagher (2002).

Three basic topics emerge from the articles on faculty and industry-university collaboration: the attitudes of faculty towards industry-university collaboration, the characteristics of faculty and universities involved in collaboration with industry, and the outcomes for the university and faculty member involved in this type of relationship. However, a quick summary on what is known will convey to the reader that only a limited amount of light has been shed on these topics.

Faculty Views of Industry-University Collaboration

An important variable to consider is faculty attitudes towards industry-university collaboration. In general, academic faculty are supportive of industry-university

collaboration in research. This support has also shown an increase in the past decade (based on retrospective data), particularly from the engineering and applied science fields. There is also an overall increase in acceptance of applied research by faculty in the past decade (again, based on retrospective data) (Lee, 1996). A large percentage of engineering faculty would like to see more industry involvement in academic research (Strickland, et. al., 1996). Support for user oriented research was more likely to come from faculty in the applied sciences and faculty who feel that user-oriented research would not interfere with the basic research mission of the university. Support for the commercialization of university research was predicted by being in an applied science discipline and by the belief that industry-university collaboration is not a threat to academic values (Lee, 1996).

Academic faculty are also open-minded towards changes in the university norms that would facilitate an increase in the amount of collaboration with industry. This means a move from the belief that the university's mission is to produce basic research towards a belief that applied research has a purpose in the university. Faculty who are involved with industry seem to want more control of this relationship in terms of the amount of time they spend working on the collaborative activity, even if this means relinquishing traditional academic duties. These faculty also respond to potential conflict in a way that would foster the collaboration with industry. However, all groups felt that the faculty member's responsibilities towards students should remain the same regardless of industry involvement. Finally, faculty that are involved in collaborative activity want a greater opportunity to obtain financial rewards and more flexibility. Faculty that are not involved in collaborative activity were more negative in their view of financial gain from this type of collaboration (Campbell, 1997; Campbell & Slaughter, 1999).

Characteristics of the Faculty Involved

Rahm (1994) showed that the type of university in which a faculty member works is important. Faculty involved in industry-university collaboration tend to come from universities that are “firm friendly”, that is, the university offers classes and workshops for firm employees, internship opportunities with firms are arranged for students, and the university is involved with companies in activities such as research consortiums. The type of research program of the faculty member is also important, faculty who are involved with industry tend to describe their research programs as multidisciplinary.

There are further differences in the research program of faculty who collaborate with industry. In addition to having been part of a multidisciplinary research program, this research is also likely to have the following characteristics: conducted by a group of collaborating investigators who are working with a grant that is relatively short in duration, and they have a more applied and product development focus than a basic research focus. When compared to research that is more federally supported, faculty with high industry supported research are more likely to rate their research as more experimental, concentrated on synthesis, oriented towards products and processes, is less long-term focused, and is pulled more by the market rather than be pushed by science and technology (Strickland, et. al., 1996).

Outcomes

Three different types of outcomes are discussed in the studies presented in this review: perceived outcomes, subjective outcomes, and concrete outcomes. One type of outcome that is discussed are perceived benefits to being involved in this type of relationship. Lee (2000) studied motivators for faculty to become involved in industry-university research

and their perceived benefits. The four motivators that faculty listed as important reasons for collaborating with industry are to secure funds for research assistant and lab equipment, gain insights into one's own research, test application of theory, and supplement funds for research. The four greatest benefits received were: acquired funds for research assistant and lab equipment, gained insight's into one's own research, supplemented funds for one's own academic research, and field tested one's own theory and research. There was also a strong correlation between the motivation to participate in research with industry and the benefit received.

Issues dealing with publications have primarily been studied in terms of delay of publications and the effect of this type of collaboration on productivity. Being involved in an industry-university research relationship is predictive of delaying publication; the primary reason for this delay is to allow time for patent applications (Blumenthol, Campbell, Anderson, Causino, & Louis, 1997). However, in this study only about a quarter of the respondents were involved in an industry-university research relationship so it is hard to predict whether data withholding is a huge problem. In terms of productivity, there are conflicting results for industry and university collaboration. Landry, Traore, & Godin, (1996) report a negative effect on productivity when the main collaborator with the university was industry. Blumenthal (1986), reported that faculty involved in industry-university research relationships showed a greater amount of publications, however these faculty were four times as likely to report that their research had resulted in trade secrets that in order to protect the proprietary value needed to be kept secret. While a later study by the same author produced similar results (Blumenthal, Campbell, Causino, & Louis, 1996), the actual percentage of faculty reporting denying other researchers access to their research

results is still rather low (11% versus 5.8% for faculty not working collaboratively with industry), suggesting that this might not be as large of a problem as previously thought.

Additional Literature Search

An additional search of the literature was conducted to ascertain if any new articles had been published on faculty and industry/university collaborations since the last review or to see if any articles were missed in the last review. Again, as with the last search, search terms such as “faculty and industry” and “academe and industry” were entered into databases to search for articles. In addition to this the citation references for the articles in the review were used to see who had cited these articles in their research. A total of three articles were located. One had been published at about the same time that the review was written, one was published earlier and had been missed in the last review, and the last one was an unpublished report that was located after the previous review had been written. Summaries of each of these articles appear below.

The first article fits into the category of the characteristics of faculty involved in industry-university relationships. Boyd and Bero (2000) assess the extent that faculty researchers who are conducting industry-sponsored research have personal contacts with their sponsors. Data were obtained from disclosure forms at a large Research I university. Results showed three types of personal relationships: occasional speaking engagements, paid consulting arrangements, and paid positions on advisory boards. In addition, a small percentage of the faculty also owned equity in the company that was sponsoring the research. The authors recommended that universities keep track of these types of relationships and establish guidelines so that such relationships do not become instances involving a conflict of interest for the faculty member.

Louis, Jones, Anderson, Blumenthol, and Campbell (2001) also did research in the area of the characteristics of faculty involved in industry-university research. In addition, they also touch upon the area of outcomes. The researchers examined whether there were differences between clinical and non-clinical life science faculty in terms of their research relationships with industry. They were also interested in ascertaining whether there were differences in the degree of secrecy or productivity for clinical and non-clinical faculty depending on the degree of entrepreneurial type behavior. Data were collected with a random nationwide sample of clinical and non-clinical faculty in life sciences departments. The results showed that clinical faculty were more likely to have grant and contract type funding from industry sponsors as opposed to non-clinical faculty. Clinical faculty also see this type of sponsorship as more important than non-clinical faculty. Since clinical faculty are typically involved at the product end of the research, they view these relationships were critical to their career. However, it was non-clinical faculty that were more involved in entrepreneurial type activities and were also more likely to report having been denied materials requested from other researchers or having denied other access to their research. While 43% of non-clinical faculty reported being denied access to research results, only 15% of clinical faculty reported denying others access to their research. It is unclear from these results whether data withholding issues are a problem. It is also not clear why faculty are withholding this information, or whether it was only withheld for a particular period of time, for instance, until a patent could be secured.

Finally, Johnson & Tornatsky (1984), focused on outcomes and assessed the success of a particular program of industry-university collaboration, the Industry-University Cooperative Projects Program. In this program, funded research projects are done jointly by

industry and university scientists. A total of 226 industry and university researchers involved in 118 projects were surveyed. Data were descriptive in nature. Results showed that each research project was done primarily by a small research team consisting of three or fewer researchers. The university researchers saw their three most important objectives as supervising the team's work, prioritizing team objectives, and disseminating team products/results. Both parties (industry and university) maintained communication primarily through phone calls and informal meetings. The three most important goals of the relationship for both industry and the university were the development of tangible products, the development of commercialized products and improvements in the manufacturing processes. Both industry and the university showed the same level of satisfaction with the technical quality of the research, the communication between groups, and the administration of the research project. However, a significantly higher percentage of university respondents were satisfied with the project's responsiveness to original project priorities.

Summary

The studies reviewed here have addressed a number of variables important to understanding industry-university research collaboration among faculty: characteristics of the university (Rahm, 1994), characteristics of the faculty member's research program (Strickland, et. al., 1996), attitudes of the faculty member towards industry-university collaboration (Campbell & Slaughter, 1999, Campbell, 1997; Lee, 1996), and the various types of outputs that are a result of the collaboration (Blumenthal et. al., 1997, 1996; Blumenthal, 1986; Landry, Traore, & Godin, 1996; Lee, 2000).

While the studies reviewed present some information about faculty and industry-university research collaboration, there are a few limitations. The main limitation is that the

data presented in these studies is primarily descriptive. Only three of the studies provide multivariate analyses: Lee (1996) on the support of user oriented research and support for the commercialization of university research; Blumenthal et. al., (1997) on delay in publication and denying access to results and; Landry, Traore, & Godin (1996) on productivity. Another limitation of the present research is in the area of methodology. Many of the studies employed nonrepresentative techniques for obtaining participants, making their results hard to generalize past that sample. Response rate was also a problem for a few of the studies. Few of the studies focused on a particular type of collaboration, instead faculty participating in any type of collaboration with industry were considered for analysis. This may create problems for the internal validity of the study, as there may not be distinct selection criteria for who is considered doing research with industry and who is not.

While this research describes generally who is supportive of industry-university collaboration, the characteristics of those involved in this type of collaboration, and some of the outcomes from it, there is clearly a need for more research in this area. There is also little discussion in the literature of what the potential gains may be for the faculty member who gets involved in industry-university collaboration. Obviously, as suggested by Lee (2000), there must be some positive outcomes for the faculty member or it would be unlikely that they would participate in these types of research relationships. While the studies on productivity (Blumenthal, 1986; Landry, Trace, & Godin, 1996) might be viewed as outcome studies, most of these studies tended to focus more on the negative aspects of the industry-university relationship. It is clear that the research needs to be expanded beyond the topic of general attitudes and into the area of outcomes.

Master's Thesis Study

In light of the fact that little multivariate research existed on faculty and industry-university collaboration and the research that did exist did focus on outcome for the most part, a master's thesis by Meagher (2002) was undertaken to expand the multivariate research in this area. This study focused on the examination of what factors predict a faculty member's satisfaction with being involved in an industry-university research relationship.

More specifically, the study was a cross sectional predictive analysis which sought to address issues concerning the relationship between various variables and faculty satisfaction in the context of industry-university research centers. Twenty independent variables at different organizational levels were examined: characteristics of the university, the center, and the individual. Faculty involved in the National Science Foundation's Industry University Cooperative Research Centers Program (IUCRC) nationwide and additional industry-university research centers at a large Research I university in the Southeast were surveyed ($n = 275$, 47.91% response rate). The dependent variables considered were the number of publications and presentations, the number of theses and dissertations, and the satisfaction of the faculty member. For the purposes of this study, the results from the multiple regression analyses for satisfaction will be discussed. For the results of the regression analyses of all the dependent variables, please refer to Meagher (2002).

The results of the multiple regression analysis showed that different organizational levels do make a difference in the prediction of satisfaction for center faculty. Variables at the institutional, the center, and the individual level predicted satisfaction for faculty members. Overall, the model predicted 35% of the variance in faculty center satisfaction.

At the university level, faculty were more satisfied when they came from universities with larger research budgets ($\underline{B}=.12$). The positive effect of the university research budget on satisfaction is not a surprising result. Larger research budgets mean more money that is available to individual faculty members, making it easier to fund their research programs without having to endure the stress of seeking external funding sources. More money from the university also means less grant money that needs to be spent on things such as equipment or overhead and more money that can be spent on the actual research. This is good for the IUCRC faculty from universities with larger research budgets, as many of the IUCRC centers receive very little funding. Therefore, faculty involved in the centers are working on a tighter budget. Faculty from universities with a larger research funding base are probably better able to cope with the marginal support than faculty at universities with a smaller funding base. It is surprising however, that center funding per faculty member did not predict satisfaction as this measure is closer to the faculty member level.

At the level of the center, faculty were more satisfied when they came from a center with a non-engineering discipline ($\underline{B} = .16$). Upon examination of the disciplines of these centers, it was shown that they represented multidisciplinary fields such textiles, health science and management, and computer software. In comparison to the applied nature of the field of engineering, these fields are of the opposite extreme than was expected, they are even more applied than engineering. Because of the extreme applied nature of these fields, an even tighter coupling with industry is required than is needed in engineering. Therefore, faculty from these centers may express a higher level of satisfaction with being involved in these centers because it brings them in close contact with industry.

At the level of the faculty member, there was more satisfaction among faculty who reported that participation in the center had a positive impact on their receipt of benefits ($\underline{B} = .23$) and on the level of symmetry they felt with industry ($\underline{B} = .34$). The positive effect of the symmetry with industry variable on satisfaction reflects that faculty who feel industry is their peer in research are likely to be more satisfied with the center. This would be a critical variable for a center to be aware of as centers with a mismatch between faculty and industry members might be less successful in their research program than those centers with a closer match.

An additional regression analysis showed that among the items on the faculty benefits scales, the most important items were increased interactions with other faculty ($\underline{B} = .22$) and access to equipment ($\underline{B} = .15$). This is important, as these are benefits that do not lead to personal gain for the faculty member. Rather, these benefits promote both collaboration and the research program of the individual faculty member. This is in agreement with the work of Lee (2000), who suggests that faculty become involved in industry-university research to advance their own research program. This also complements the results of Gray, Johnson, and Gidley (1986) who state that faculty and industry participants from center programs have a primary goal of a general expansion of knowledge rather than patentable products.

Summary

The results of this study showed that variables operating at different organizational levels are important when predicting faculty member satisfaction with industry-university research centers. More specifically, variables at the university, center, and individual were predicative of satisfaction. Faculty are more satisfied when they come from a university with a larger research budget, the center they are involved with is a non-engineering discipline,

they perceive a greater level of symmetry with industry, and they are receiving benefits. The most important benefits are access to equipment and interaction with other faculty, both of which promote collaboration and the research program of the faculty member.

While the above research did shed some light in the area of faculty satisfaction with their involvement in industry-university research, there were some shortcomings. The major limitation was that the research was restricted to the construct and items included in a preexisting survey, already in use by the IUCRC program to evaluate center faculty. Therefore, there was a limited set of predictors of satisfaction that could be examined. Second, though the satisfaction scale did show adequate reliability, it was also a limited measure of the construct. There were additional items that could be added to make it more complete. For example, a beneficial addition to the scale would be a variable that asks the faculty member how satisfied there were with the relevance to the research program to his or her own needs or what is his or her overall center satisfaction. Finally, the study did not examine possible consequences of satisfaction. Based on the results of the master's thesis study, there are many possible directions to take further the research on faculty and industry/university collaboration and especially on faculty involvement in IURCs. Knowing what predicts a faculty member's level of satisfaction is important, but it is also just as important to know why university officials and policy makers should be concerned with the level of satisfaction of their faculty.

A New Direction for Faculty Research: Understanding Faculty Commitment and Retention

Faculty are an important part of the industry-university research center. It is through the faculty member that the main function of the center gets accomplished, the completion of research projects. Among the duties of the faculty member are the development and

conducting of center research (with the help of graduate students), communicating with both industrial members and other faculty researchers in the center about the progress and results of their research, and help with the recruitment and retention of industry members (Gray & Walters, 1998). Therefore, a center's success is dependent on the recruiting and retention of top-notch faculty members in the research areas in which the centers is specialized. This job of recruiting faculty members falls primarily onto the center director. It is important to remember that for faculty, the decision to become involved in an IURC is entirely a voluntary one, as research funding could be obtained from a variety of alternative sources. This makes the composition of the employees in a center an entirely volunteer workforce. Because of this, once a faculty member has been recruited and shown to be a successful part of the center, it is in the best interests of the center to retain the faculty member. Thus, knowing what contributes to a faculty member's satisfaction with their center involvement and ultimately retention appear to be important issues from both a management and a policy perspective and will be the focus of the current research project.

A Conceptual Model for Linking Satisfaction and Organizational Commitment

The High Performance Cycle developed by Locke and Latham (1990) is a model that addresses many of the factors that might contribute to understanding faculty satisfaction and retention. Figure 1 shows the High Performance Cycle. In this model, high goals and high self-efficacy lead to a high level of performance. This high level of performance produces rewards, which then lead to satisfaction. The outcome of satisfaction is commitment to the organization, which in turn feeds back to the beginning of the model with increased commitment to future goals and also moderates the relationship between goals and performance. The second part of this model, appears to have the most relevance to the case

at hand. That is, a high level of performance on center related research should lead to satisfaction with center involvement, mediated by the receipt of rewards. This satisfaction would in turn lead to a greater commitment to the center, which would then have an effect on future performance. Figure 2 shows the portion of the model that would apply to faculty involved in industry-university research centers.

Before a model of satisfaction and organizational commitment can be tested with faculty from industry-university research centers, the key concepts of the model must be examined more closely to ascertain if there are any variables missing in the model and how these concepts might apply to faculty involved in an IURC. The following three sections include reviews of the literatures on rewards, job satisfaction, and organizational commitment. Next, the literature focused on the relationship between job satisfaction and organizational commitment will be discussed. Finally, a revised model will be presented that includes important variables discussed in these literatures. Since faculty and especially faculty involvement in I/U are rarely touched upon in these literatures, the end of each section will discuss how these concepts might apply to this population.

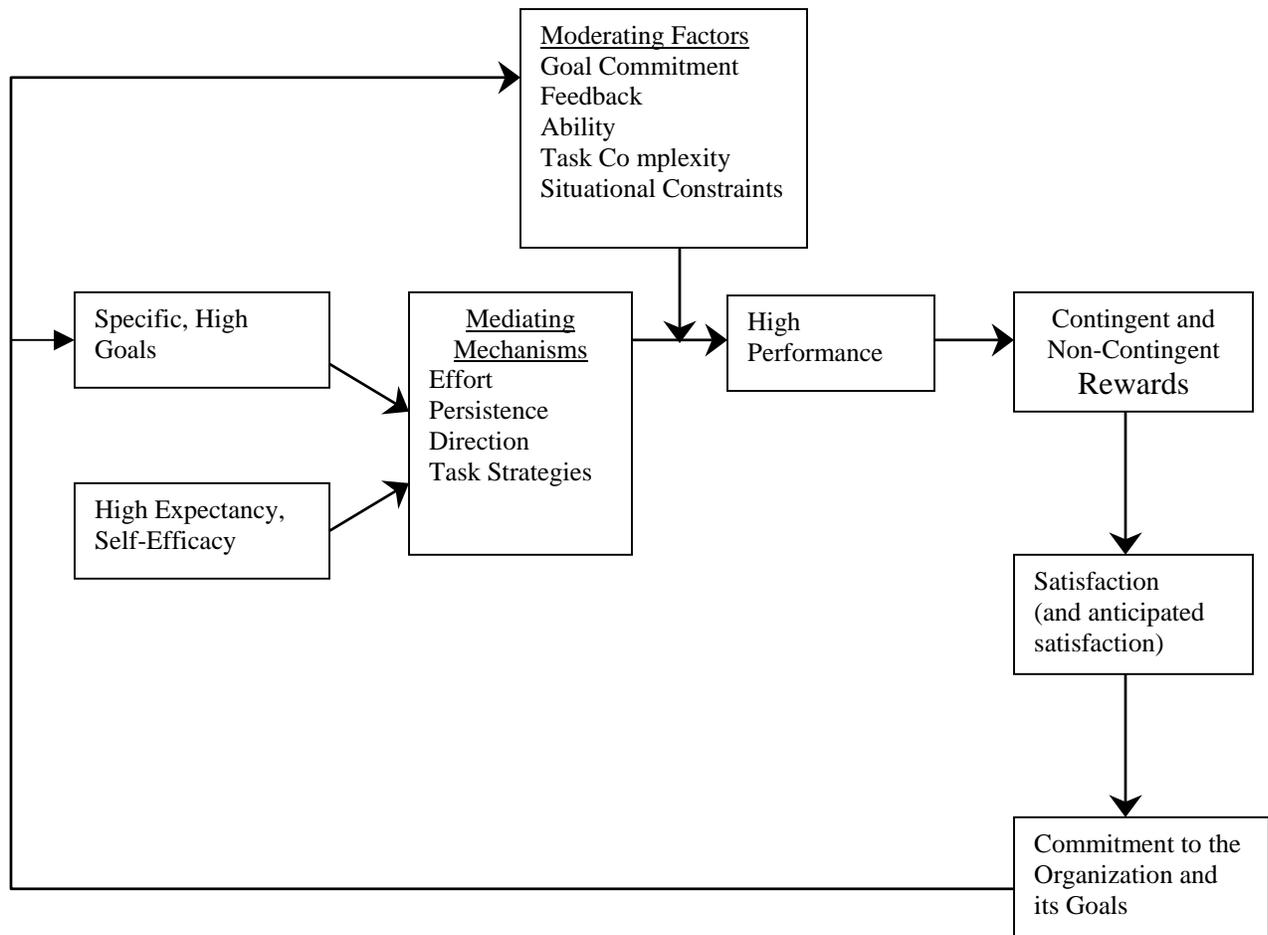


Figure 1: The High Performance Cycle. From: Locke & Latham (1990)

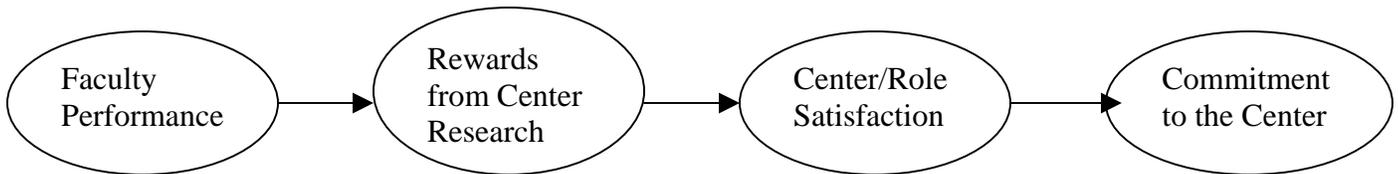


Figure 2: Latent Factors Model

Rewards

In the High Performance Cycle, successful performance leads to the receipt of rewards. Mottaz (1985) discusses three dimensions of rewards: task, social, and organizational. Task rewards refer to intrinsic rewards that are directly associated with the employee's job. For example, task autonomy is the degree to which the employee has self-direction doing the task. Social rewards are extrinsic rewards that come from interacting with others while on the job. Example would be the degree to which coworkers assist with the employee's job. Finally, organizational rewards are extrinsic rewards that the organization provides to its employees in order to facilitate or motivate task performance, for example receiving adequate fringe benefits. The authors assessed the importance of each of these types of rewards with six types of organizations (university, elementary schools, plastics factory, order-processing firm, hospital, and law enforcement agency) and five occupational groups with those organizations (professional, managerial, clerical, service, blue-collar, $n = 1,385$). Analyses were done via ANOVAs and multiple regression. Across all occupational groups, workers placed the greatest amount of importance on the intrinsic

task rewards ($F = 140.26$, $p < .00$, for professional, $F = 43.30$, $p < .00$, for managerial, $F = 33.23$, $p < .00$ for clerical, $F = 72.23$, $p < .00$, for service, and $F = .974$, $p < .00$). This was also the strongest predictor of overall work satisfaction for all occupational groups ($B = .51$, $p < .05$, for professional, $B = .57$, $p < .05$, for managerial, $B = .49$, $p < .05$, for clerical, $B = .64$, $p < .05$, for service, $B = .38$, $p < .05$, blue-collar). Extrinsic social rewards were the next in importance across all occupational groups; they were also a strong predictor of work satisfaction as well. Extrinsic organizational rewards had the lowest level of importance across all occupations and were a significant predictor of work satisfaction only for the lower occupation levels (clerical, service, and blue collar). When looking between occupational groups, workers in the upper occupational groups (professional and managerial) assigned greater importance to intrinsic task rewards (7.76 for professional employees, versus, 5.56 for blue collar employees) while, workers in the lower occupational groups (clerical, service, and blue-collar) assigned greater importance to extrinsic organizational rewards (3.82 for professional employees, versus 5.10 for blue-collar employees).

Bokemeier and Lacy (1986) proposed that job rewards (conceptualized as pay, prestige, stability, and financial situation) and job values (income, security, promotion, and meaningful work) have a direct effect on job satisfaction. They also proposed that work conditions (current employment status, and hierarchy of supervision) and individual attributes (education, age, social class, and race) have an indirect effect on job satisfaction, which is mediated through job rewards and job values. The data that were used for analysis was a part of the General Social Survey ($n = 4,376$). Analyses were done via multiple regressions, for both men and women, an overall analysis was not performed. For women, the results showed some support for the proposed relationships. While working conditions

had no direct effect on satisfaction, the individual attributes of age, education, and social class did have a direct effect. When job rewards and values were added to the model, only the effect of age remained significant. For men, all working conditions and the individual attributes of age and social class had a direct effect on job satisfaction. When job rewards and job values were added to the model, these effects became non-significant, consistent with a mediating relationship. For women, the rewards of prestige and financial situation and the values of promotion and meaningful work had a direct effect on satisfaction. For men, the rewards of prestige, unemployment, and financial situation and the value of security had a significant effect on satisfaction. Overall, the percentage of men and women who reported being very satisfied with their job was almost identical (49.4% for men, and 50.1% for women). However, for men the job value with the strongest relationship to job satisfaction was security ($B = .072, p < .01$), for women it was a preference for meaningful work ($B = .087, p < .01$).

In a study of employees from a company in the U.K., Oliver (1990) sought to determine the relationship between organizational rewards, employee values, and organizational commitment. There were three types of organizational values: instrumental, which examined things such as job security, working conditions, and fairness of income; participatory, which examined an employees opportunities to participate in decision making, having good relations with management and coworkers, and working for the benefit of one's self and others; and task centered, which focuses on aspects of the employee's job such as being able to use one's skills. In addition to measuring the level of importance each of the participants placed on these values, they were also asked the degree to which each of these values were supplied by the organization in terms of rewards. A multiple regression analysis

showed that commitment was explained by the overall receipt of rewards ($B = .43, p < .05$), participatory values ($B = .31, p < .01$), instrumental values ($B = -.30, p < .01$), and tenure ($B = .25, p < .05$). Overall rewards (which was the receipt of rewards across all three types of values) had the strongest relationship with commitment, followed by each of the types of values. The reasoning given by the authors for the negative relationship between commitment and instrumental values is that employees who place a high importance on these values may expect above and beyond what is feasible by the organization, thus creating a lower level of commitment when these expectations are not fulfilled.

Mottaz (1988) examined the relationship between work rewards, work values, and organizational commitment. There were two types of rewards: intrinsic rewards and extrinsic rewards. Intrinsic rewards were awards associated with doing the job itself and were measured as the level of task autonomy, task significance and task involvement in the job. Extrinsic rewards were divided into two categories: extrinsic social rewards, measured as the amount of supervisory and coworker assistance in the job, and extrinsic organizational rewards measured in terms of adequate working conditions, pay equity, promotional opportunity, adequate fringe benefits, and income level. Work values were measured as a rating of the relative importance of each of the work rewards. Data was collected in six different organizations and across five occupational groups within those organizations ($n = 1,385$, See Mottaz (1985)). A multiple regression analysis showed that work rewards had a stronger relationship to organizational commitment than work values. For example, while the rewards of task autonomy showed a significant standardized beta of .207 with organizational commitment, the value of task autonomy showed a significant standardized beta of -.044. Work rewards had a positive effect on organizational commitment while work

values had a negative effect. Similar to Oliver (1990), the authors reasoned that this negative relationship is due to the fact that the more an employee values a certain work reward, the less likely it is to be fulfilled to the standards of the employee, hence cause a lower level of commitment. Intrinsic rewards had the strongest relationship with organizational commitment ($B = .207, .224, \text{ and } .360$ for task autonomy, significance, and involvement respectively, $p < .05$) followed by extrinsic social rewards ($B = .095$ and $.063$ for supervisory and coworker assistance respectively, $p < .05$). Extrinsic organizational rewards had the smallest influence on organizational commitment ($B = .064$ and $.065$ for salary and promotional opportunity respectively, $p < .05$, working conditions and fringe benefits were not significant), suggesting that it is the nature of the employees job itself that determines the attitude toward the organization.

In a meta-analysis Cohen and Gattiker (1994) examined whether the relationship of rewards and organizational commitment varied across organizational type, organizational size, or occupational level of the employee. The extrinsic reward of income was used, a total of 21 studies examined the relationship between income and organizational commitment and an additional 27 studies focused on the relationship between pay satisfaction and organizational commitment. While there were no differences in the relationship between income and organization commitment or pay satisfaction and organizational commitment for either organizational size or occupation status, there was a significant relationship for rewards and organizational type. More specifically, the relationship between pay satisfaction and organizational commitment was significantly stronger for private organizations ($r = .45$) than for public organizations ($r = .12$). However, since this study used a very limited

definition of rewards, it is hard to say whether these results would generalize across all types of rewards.

Fraser and Hodge (2000) surveyed university faculty ($n = 179$) on age, job satisfaction, extrinsic rewards, intrinsic rewards, organizational commitment, embracement of diversity, organizational fairness, and quality of worker ties. Analyses were done via multiple regressions. They found no significant differences between males and females on their level of job satisfaction. However, for both men and women, the receipt of intrinsic rewards was a significant predictor of job satisfaction ($B = .333, p < .001$), for men it was the strongest predictor ($B = .393, p < .001$), for women the second strongest predictor after co-worker ties ($B = .201, p < .05$). Extrinsic rewards were not a significant predictor of job satisfaction. Across both samples, 52.3% of the variance in job satisfaction was explained.

Summary

Rewards can be divided into two main types: intrinsic and extrinsic rewards (Mottaz, 1988). Across all occupational groups (including university professors), workers appeared to place the greatest importance on intrinsic task rewards. Extrinsic social rewards and organizational rewards were also important predictors of work satisfaction, however these relationships were not as strong as for intrinsic rewards (Mottaz, 1985). This may be especially true for faculty, as only intrinsic rewards were a significant predictor of job satisfaction (Fraser & Hodge, 2000).

Research has shown that job rewards have a direct effect on job satisfaction. They also mediate the relationship between both work conditions, individual attributes and job satisfaction (Bokemeier & Lacy, 1986). Organizational commitment was also predicted by the overall receipt of rewards (Oliver, 1990). Work rewards had a stronger relationship to

organizational commitment than work values (Mottaz, 1988). Finally, the relationship of rewards and organizational commitment did not vary across organizational size, or occupational level of the employee (Cohen & Gattiker, 1994).

In Lee's (2000) study of motivators for faculty to become involved in industry-university research, there was a strong correlation between the motivation to participate in research with industry and the benefit received. It is reasonable to assume that faculty enter into a research relationship with industry expecting certain rewards and their level of satisfaction and commitment with the relationship may be dependent on the receipt of these rewards. Faculty can receive many rewards, both intrinsic and extrinsic from their involvement in industry-university research centers. For example, in terms of intrinsic rewards, there is a feeling of accomplishment that the faculty member receives from undertaking research in their field of interest. On the extrinsic side, the funding received from industry allows the faculty member to more efficiently carry out his or her research and provide support to graduate students. Center involvement may provide access to equipment that might not otherwise be available and provide contact with other colleagues. There may also be opportunities to obtain consulting work with industry or to obtain additional research contracts. Finally, involvement in the center may increase chances of promotion or tenure. The receipt of these rewards may increase the faculty member's satisfaction with their center involvement and also increase their level of commitment to the center.

Job Satisfaction

While it is beyond the scope of this study to do an exhaustive review of the literature on job satisfaction, the following review will attempt to cover key concepts and issues.

Job satisfaction is one of the most commonly researched topics in organizational psychology. It is defined by Locke (1976) as “a pleasurable or positive emotional state resulting from the appraisal of one’s job or job experiences (p. 1300)”. Spector (1997) defines it more simply as “...the extent to which people like (satisfaction) or dislike (dissatisfaction) their jobs (p. 2)”. Keeping employees happy in their work is intuitively appealing to employers in many organizations. Job satisfaction can be a global, overall feeling, which would encompass every aspect of the employee’s job or it can be a focused construct pertaining to just a few aspects of an employee’s job.

An in depth look at the antecedents and consequences of job satisfaction was done by Kinicki, McKee-Ryan, Schriesheim, & Carson (2002) in their meta-analysis of the Job Descriptive Index (JDI). The JDI measures job satisfaction in term of facets: satisfaction with work, supervision, coworkers, pay, and promotion. Each facet represents a scale in the questionnaire. The researchers examined 152 studies that used the JDI in their research. Their review divided up the dimensions into antecedents, correlates, and consequences of job satisfaction. Antecedents were predictors of job satisfaction; correlates were variables in which the exact causal relationship could not be determined; and consequences were variables predicted by job satisfaction. Average correlations across all five facets are reported below, for a more in depth analysis, refer to Kinicki et. al. (2002).

Four antecedents were considered: job characteristics, role states, group and organizational characteristics, and leader relations. Job characteristics were measured as the five core job dimensions of the Job Characteristics Model (Hackman, Oldham, Jansen, and Purdy, 1975): skill variety (the degree to which a worker’s skills and abilities are challenged), task identity (the degree to which the employee’s job require the completion of

an identifiable outcome), task significance (the degree to which the job has an impact on the lives of other people), autonomy (the degree to which the job give the worker freedom in scheduling and decision making), and feedback (the degree to which the worker receives information on the effectiveness of his or her efforts). The average correlation across all five subscales of the JDI with each of the characteristics was .24, meaning the higher the degree to which the job contained the above characteristics, the greater the level of job satisfaction of the employee. Two role states were considered, role ambiguity and role conflict, and both had a negative relationship with satisfaction (-.35 and -.32 respectively). Group and organizational characteristics (which included variables such as group goal arousal, group cohesiveness, organizational structure, and organizational climate) showed positive average correlations with the JDI facets ($r = .25, .31, .31, .20, \text{ and } .25$ for coworkers, work, supervision, pay, and promotion respectively). Finally, leader relations (initiating structure, consideration, reward behavior, etc...) were considered. These variables showed the largest correlation with the supervision facet of satisfaction ($r = .55$) compared to the average for the other facets ($r = .18$) (Kinicki et. al., 2002).

The correlates of job satisfaction that were considered were organizational commitment, work and non-work stress, poor health symptoms, job involvement, and life satisfaction. Organizational commitment ($r = .44$), job involvement ($r = .42$ with work satisfaction), and life satisfaction ($r = .27$ with work satisfaction) showed positive correlations with job satisfaction. The stress variables ($r = -.25$) and poor health symptoms ($r = -.13$ with work satisfaction) showed negative relationships with job satisfaction (Kinicki, et. al, 2002).

Finally, the consequences of job satisfaction studies were motivation, citizenship behavior, withdrawal cognitions, withdrawal behaviors, and job performance. There was a

positive relationship between job satisfaction and motivation; the average correlation was .26. Citizenship behavior also showed positive correlations with all facets of the JDI except promotion, where no data was available. There was a stronger relationship for withdrawal cognitions (intention to leave and pre-withdrawal cognitions) than actual withdrawal behaviors (turnover, absenteeism, lateness, and days of sick leave). The average correlation for withdrawal cognitions was -.37 versus an average correlation of -.15 for withdrawal behaviors. Finally, job performance had an average correlation of .19 with job satisfaction (Kinicki et. al., 2002).

A common belief is that people who are satisfied with their jobs will show a high level of productivity. However, the results of research on productivity as a consequence of job satisfaction have shown that the relationship is not as strong as previously thought. A meta-analysis of 217 correlations between measures of satisfaction and performance showed that the average correlation was .146. This did not vary depending on which satisfaction or performance measure was used (Iaffaldano & Muchinsky, 1985). This is almost identical to the correlation of .14 reported by Vroom in 1964 in a review of 20 studies focusing on this relationship. It also is only slightly lower than the correlation of .19 reported by Kinicki et. al. (2002) above. It appears that job satisfaction influences other variables such as organizational citizenship behavior and organizational commitment rather than having a strong direct effect on performance.

Job Satisfaction of University Faculty

When dealing specifically with the job satisfaction of university faculty, it is important to remember that this occupation is unique because of the large amount of preparation (many years of schooling, experience in teaching and research, publications) that

is required for the job. This process can take anywhere from 7 to 10 years to complete (Corcoran and Clark, 1984). A literature search was conducted to find articles pertaining to the job satisfaction of university faculty. Keywords such as “faculty and satisfaction” and “job satisfaction and academia” were entered in to journal databases. The studies located are reviewed below.

Faculty find many things about their job both satisfying and unsatisfying. In a descriptive study of job satisfaction Oshagbemi (1997) surveyed faculty (n = 566) from the United Kingdom to find aspects of their jobs that lead to satisfaction and dissatisfaction. Faculty were asked to rate their level of satisfaction or dissatisfaction with eight aspects of the job: teaching, research, administration and management, present pay, promotions, supervision/supervisor behavior, co-worker’s behavior, and physical conditions, working facilities. In addition to the ratings, respondents were also asked to list five aspects of their job that they felt contributed to their satisfaction and five aspects, which contributed to their dissatisfaction. Teaching and research explained most of the satisfaction and dissatisfaction (50% and 30% respectively) in faculty jobs. Additional factors that contributed to satisfaction were co-worker’s behavior and physical conditions of the workplace as well as a great number of individual responses such as; enthusiasm of students, supervision of student projects, academic freedom and research collaboration. Additional factors that contributed to dissatisfaction (besides teaching and research) were the physical conditions of the workplace and individual responses such as demands of individual students, little recognition of teaching skills, pressure to publish, and funding for research (Ogeshemi, 1997).

Locke (1984) conducted an exploratory study of the job satisfaction with faculty at a major state university in the U.S. Overall the level of satisfaction expressed by faculty was

slightly above neutral. The results showed that faculty are looking for the same things from their jobs as employees in other organizations, mainly a sense of achievement for their work, clarity in their work role, fairness in pay and promotions, working facilities that are of good quality and leaders and coworkers who facilitate effective work and are also respectful and honest. Faculty were most satisfied with their work achievement, their department chairs, and their fellow faculty and least satisfied with administration at higher levels, pay, and promotions.

Kinicki et. al., (2002) showed that there is a negative relationship between withdrawal (both cognitions and actual withdrawal) and job satisfaction. Therefore, one way of determining what contributes to job satisfaction for faculty would be to look at why faculty members decide to stay at their current position or move either to a new university or to the private sector (thus showing withdrawal behaviors). Faculty members at two Research I universities (n = 221) who were offered new positions at another school were surveyed 6 months after their decisions to accept or decline job offers at other schools or firms. Forty-six percent of the respondents did leave their current position to take another offer. Each participant (both those who stayed and those who left their current position) indicated which factors of the job were key in making his or her decision, out of a list of 33 possible factors. The analysis of the results was primarily descriptive in nature. Reasons listed were divided into three categories: intangible benefits (out of the control of the faculty member, for example the reputation of the institution), tangible benefits (features that are somewhat controllable by the faculty member, for example the amount of research funding received), and non-work related benefits (characteristics of the surrounding community in which the university is located, such as the cost of housing and the quality of area schools). At both

schools, the top enticements (characteristics of the university offering the new position) to leave the current university were: cash salary, income potential, rapport with department leaders, and career advancement opportunities. The top enticements (characteristics of the university the faculty member was currently working) to remain at the current university were: reputation of institution, library facilities, reputation of department, cultural, social, and recreational opportunities, research opportunities, and loyalty to the department or program. Overall, the top ten reasons for either staying or moving included a mix of tangible and intangible benefits however, the majority were intangible benefits (Matier, 1990). These factors suggest that faculty may not only be concerned with the job they do but they may also be concerned with the environment in which they work and the surrounding area in which the school is located.

Fernandez and Mateo (1993) created a questionnaire to measure the satisfaction of faculty with the academic setting. It was developed using faculty ($n = 748$) at a major university in Spain and it consisted of 36 items, all answered on a point seven point Likert scale. Through factor analysis, they found that the items loaded onto three factors (satisfaction with working conditions, social climate, and relationships with students), which accounted for 78% of the total variance in satisfaction with the academic setting. These factors are also mentioned faculty in the Matier (1990) study concerning enticement to stay or leave the university in which a faculty member is currently working. Items such as congeniality of associates, rapport with department leaders, lab/research facilities, and library facilities are a few of the items in the Matier (1990) study that are related to the factors in the academic setting questionnaire. Features of the organization in which a faculty member

works might have an important effect on their job satisfaction and should be considered in research in this area.

Hagedorn (1994) examined faculty at three different career stages, early, in which retirement was 25 or more years away, mid-career, in which retirement was between 15 and 20 years away, and late career (termed “disengagers” by the author), in which retirement was 5 or less years away. These faculty were from all types of four year institutions, and a small percentage were from two year institutions. A model of job satisfaction was hypothesized, which contained the following exogenous independent variables: satisfaction with administration, satisfaction with salary, sum of weekly hours spent in institutional duties, and perceived support of colleagues. The five endogenous independent variables in the model were: perceived level of enthusiasm with one’s discipline, perceived level of importance of one’s department and university, perceived level of stress, perceived level of student scholarship, and the enjoyment of interaction with students. The dependent variable in the model was satisfaction in academe. The model was tested for goodness of fit with each group of faculty using structural equation modeling. The chi- square to degrees of freedom ratio and the goodness of fit index both showed values that were well within the range of a well-specified model for all three groups of faculty. The variance in satisfaction explained by the model was highest for the disengagers, 40.7%. This was followed by the mid-career faculty at 34.6% and finally the early career faculty at 30.5%. For novices, satisfaction in academe was indirectly predicted by satisfaction with administration, satisfaction with salary, sum of hours, and perceived support of colleagues. It was directly predicted by level of enthusiasm for one’s discipline, perceived level of stress, enjoyment of student interaction, and satisfaction with administration. For mid-careerists, there were indirect effects for

satisfaction with administration, satisfaction with salary, sum of hours, and perceived support of colleagues. There were direct effects for satisfaction with salary, importance of department and university, perceived level of stress, and perceived level of student scholarship. Finally, for disengagers, there were indirect effects for satisfaction with administration and perceived support of colleagues, and direct effects for satisfaction with salary, importance of department and university, perceived level of stress, and perceived level of student scholarship. Three variables had significant total effects across all three career levels: satisfaction with administration, satisfaction with salary, and perceived level of stress.

From the results of this earlier study, Hagedorn (2000) developed a conceptual framework of faculty job satisfaction. This framework contains three categories of “mediators” or variables that influence the relationship between other variables and “triggers” which are significant life events that may be related or unrelated to the job. There are three types of mediators: motivators and hygienes (recognition, salary), demographics (gender, minority status), and environmental conditions (relationships with colleagues, institutional climate). Examples of possible triggers are a change in family circumstances or a transfer to a new institution. These concepts all contribute to job satisfaction which is represented as a continuum with disengagement on one end and actively engaged in work at the other end. A preliminary test of the validity of the model with data from the 1993 National Study of Postsecondary Faculty showed that the mediators predicted 49% of the variance on a global measure of faculty job satisfaction. The most predictive variables were the work itself, salary, relations with administration, student quality and relationships, and institutional climate and culture.

Finally, it is important to consider that there may be gender differences in the job satisfaction of faculty. Since the academic world was predominantly a male occupation until the latter half of the last century, it is possible that there are different predictors of satisfaction for males than for females. Tang and Talpade (1999) tested difference in job satisfaction for faculty and staff at a large public university ($n = 110$). Analyses were performed via MANOVAs. Their results showed that males tended to have a higher level of satisfaction with pay than females ($\underline{M} = 27.93$ for males versus $\underline{M} = 21.98$ for females), and females tended to have a higher level of satisfaction with co-workers than males ($\underline{M} = 46.39$ for females and $\underline{M} = 33.91$ for males).

Fraser and Hodge (2000) surveyed university faculty ($n = 179$) on age, job satisfaction, extrinsic rewards, intrinsic rewards, organizational commitment, embracement of diversity, organizational fairness, and quality of worker ties. Analyses were done via multiple regressions. The prediction of job satisfaction yielded different models for men and women. For women, job satisfaction was predicted by age ($B = .058, p < .01$), intrinsic rewards ($B = .201, p < .05$), and quality of co-worker ties ($B = .485, p < .01$). For males, job satisfaction was predicted by intrinsic rewards ($B = .393, p < .001$), organization commitment ($B = .136, p < .05$), embracement of diversity ($B = .114, p < .01$), and organizational fairness ($B = .161, p < .01$).

Summary

Job satisfaction is a well-studied concept in organizational psychology. It is defined by Locke (1976) as “a pleasurable or positive emotional state resulting from the appraisal of one’s job or job experiences (p. 1300)”. In terms of antecedents of job satisfaction, the higher the degree to which a job contains job characteristics such as skill variety and

autonomy, the greater the level of job satisfaction of the employee. Employees are less satisfied with jobs that show a greater degree of role ambiguity and role conflict.

Organizational characteristics such as group goal arousal, group cohesiveness, organizational structure, and organizational climate are positively related with satisfaction. Finally, leadership characteristics showed a strong correlation with job satisfaction; suggesting the importance of the leader in influencing the employee. Though the direction of a causal relationship was not stated, organizational commitment, job involvement, and life satisfaction showed positive correlations with job satisfaction. Also, stress and poor health symptoms showed negative relationships with job satisfaction (Kinicki et. al., 2002).

In terms of the consequences of job satisfaction, motivation and citizenship behavior show a positive relationship with satisfaction. Withdrawal cognitions and actual withdrawal behaviors both showed a negative relationship with satisfaction, although the relationship was stronger for cognitions. This suggests that while an employee may be dissatisfied with their job and intend to leave, new opportunities may not be available to them. Finally, though a common belief is that a “happy worker is a productive worker” (Staw, 1984), job performance had an average correlation of .19 with job satisfaction (Kinicki et. al., 2002). This result is only slightly higher than the results found in another meta-analysis of correlations between measures of satisfaction and performance, in which the average correlation was .146 (Iaffaldano & Muchinsky, 1985).

The literature mentions a number of variable domains that may contribute to the job satisfaction of faculty members. The first group of variables involves organizational factors such as the working facilities (Oshagbemi, 1997), time constraints placed on the faculty member, relations with department chairs and coworkers (Locke, 1984, Oshagbemi, 1997,

Matier, 1990, Fraser & Hodge, 2000, Hagedorn, 2000), and the amount of support received from their environment (Neumann & Neumann, 1998). The next group of variables concerns rewards and recognition, which involves things such as opportunities for promotion, professional identity, influence in the department (Matier, 1990, Fernandez & Mateo, 1993), and the receipt of intrinsic rewards (Fraser & Hodge, 2000). Finally, there are financial factors such as the salary or research funding that is available (Locke, 1984, Matier, 1990, Fernandez & Mateo, 1993, Hagedorn, 2000).

In addition to being a participant in an IURC the faculty in this study are also members of academic departments and have responsibilities there as well. Therefore the focus of satisfaction in this study is on a subset of the faculty member's job, their role as a researcher in an IURC. Nonetheless, many of the factors that contribute to the job satisfaction of faculty could translate into a center context. Clearly organizational factors could have an impact, not only in terms of the actual physical conditions of the research space, but also in terms of the time constraints placed on the faculty member by industry sponsors and center administration, as well as the quality of relations with other center researchers, center administration, and industry representatives. Rewards and recognition the faculty member receives for their center related research and efforts to make the center successful could also impact whether they feel satisfied with their involvement or committed to the center. Finally, the level of center funding for research could also impact whether a faculty member feels committed to continuing doing research in that center.

Organizational Commitment

The final component of the model is organizational commitment. The most commonly used definition of organizational commitment in the literature is that of Mowday, Steers, and Porter (1979): “the relative strength of an individual’s identification with and involvement in a particular organization” (p. 226). The authors identify three dimensions, which characterize commitment. First, there is a strong belief in and acceptance of the organization’s goals. Second, there is a willingness to exert considerable effort on behalf of the organization. Third, there is a strong desire to maintain membership in the organization. They argue the commitment is a more global construct than job satisfaction, it reflects an affective response to the organization as a whole. Job satisfaction is more localized, reflecting a response to one’s specific job or particular aspects of that job.

Since the creation of this definition, other authors have also attempted to define the concept of organizational commitment. Mathieu and Zajac (1990) divide commitment into two main types: attitudinal and calculated commitment. Attitudinal commitment would be similar to the affective commitment described above. Calculated commitment is defined as “a structural phenomenon, which occurs as a result of individual-organizational transactions and alterations in side bets or investments over time” (p. 172). If an individual has invested a great deal in an organization over time both in concrete terms (e.g., pension plan) and in psychological terms (e.g., acceptance of the organizations goals) he or she may be less likely to consider leaving an organization and losing these investments. This may translate into a partnership context, a researcher who has invested a good number of years in a research program, or even in a specific project may be more likely to stay committed to the relationship in order to see the project through to its completion.

Allen & Meyer (1990) discuss three different types of commitment. Affective commitment is similar to the definition of Mowday, Steers, and Porter (1979), that the individual identifies with, is involved in, and enjoys membership in the organization and is also similar to the concept of attitudinal commitment described by Mathieu and Zajac (1990). Continuance commitment is commitment based on the costs that the employee associates with leaving the organization, which is similar to calculated commitment described by Mathieu and Zajac (1990). Finally, normative commitment is the employee's feeling of obligation to remain with the organization, staying because they feel it is the "right thing to do". This type of commitment is based on the experiences (both cultural and organizational) of the employee before entering the organization. The authors propose that an employee could hold different levels of the three types of commitment at any one time.

The most commonly used questionnaire to measure organizational commitment is the OCQ developed by Mowday, Steers, and Porter (1979). It consists of 15 positive and negative worded items, which the authors intended to form a uni-dimensional construct of commitment. However, in recent years, the validity of this instrument has come into question, particularly in terms of its factor structure. The organizational commitment survey (OCS) was created as an alternative to the OCQ, originally developed for use with public employees (Balfour & Weschler, 1996). Three dimensions of organizational commitment are represented in the measure: identification, affiliation, and exchange commitment. However, the content of the survey suggests that it is conceptually a much different measure of commitment than the OCQ. A more comprehensive discussion of these scales will appear in the methods section.

Antecedents and Consequences of Commitment

Many studies have looked at what predicts organizational commitment. Lok & Crawford (2001) examined four possible antecedents of organizational commitment (as measured by the OCQ): organizational culture, organizational subculture, leadership, and job satisfaction. Nurses ($n = 251$) were surveyed on each of these measures. Analyses were done via multiple regressions. Results showed that organizational subculture (in this study, the specific ward that the nurse worked in as opposed to the hospital culture in general) was more important than organizational culture (the hospital) at predicting commitment ($B = -.16$, $p < .05$ and $.34$, $p < .01$, for the degree to which the ward culture was viewed as bureaucratic or innovative respectively, all results for the hospital culture were non-significant). Also, leaders who showed a consideration style of leading had a more positive effect on the commitment of their employees ($B = .25$, $p < .01$) than those who showed an initiating structure style ($B = .04$, $p > .05$). There was a positive relationship between age and commitment ($B = .23$, $p < .01$); older nurses were more committed to their job than younger nurses. Finally, job satisfaction had a positive effect on commitment ($B = .19$, $p < .01$). A total of 47% of the variance in commitment was explained by the model.

In their creation of the OCS, Balfour and Weschler (1996) tested a model of organizational commitment with public employees in 12 state government agencies ($n = 828$). The model contained individual and organizational antecedents of commitment (participation, job scope, position, political penetration, supervisor, tenure, education, pay satisfaction, learning, advancement, and internal motivation), which predicted the three dimensions of commitment as measured by the OCS (identification, affiliation, and exchange commitment), which in turn predicted the outcome variables (desire to remain, turnover

intent, and extra-role behavior). Analyses were done via structural equation modeling. The model predicted 87% of the variance in the dependent variables (the three commitment types and the outcomes variables). Participation, political penetration, supervision, and opportunity for advancement had significant effects on all three types of commitment. Participation, supervision, and opportunities for advancement all had a positive effect on the three types of commitment; political penetration had a negative effect on the three types of commitment. The individual characteristics of tenure, education, and position did not have a significant effect on the three types of commitment. In terms of consequences of the three types of commitment, all three types had a positive multivariate effect on the desire to remain in the organization. Affiliation commitment also had a positive effect on the performance of extra-role behaviors in the organization. The authors conclude that commitment is for the most part a function of both work experiences and characteristics of the job and organization, since individual predictors had no effect on commitment. “Commitment is bolstered or diminished as a result of organizational policies and practices (Balfour & Wechsler, 1996, p. 272).”

In a meta-analysis of about 200 articles, Mathieu & Zajac (1990) studied the overall effects of many antecedents, correlates (variables whose exact causal relationship could not be conclusively determine but which do exhibit a relationship with commitment), and consequences of organizational commitment. For the antecedents, individual characteristics showed only small correlations with commitment. People who are older ($r = .201$), female ($r = -.145$), and married ($r = .106$) tend to have a higher level of commitment, whereas, those with higher levels of education ($r = -.092$) tend to have lower levels of commitment, although the size of this relationship was quite small. Organizational tenure ($r = .170$) also had small

significant positive correlation with commitment suggesting that those who have worked for a number of years at an organization may be more committed than lesser tenured employees. The largest correlation for the antecedents of commitment was perceived competence of the employee (the degree to which the employee feels competent in doing his or her job) ($r = .630$). The authors interpret these results, as people will become more committed to an organization to the degree that it provides for growth and achievement needs. A variable defined as job scope, which was an average of the core job dimensions from the job characteristics model (skill variety, task identity, task significance, autonomy, and feedback) also showed a large positive correlation with commitment ($r = .503$), meaning that employees showed more commitment to the organization to the extent that their jobs contained these job characteristics. Leader communication ($r = .454$) and participatory leadership ($r = .386$) exhibited moderate positive correlations as well.

Six different correlates of organizational commitment were considered. These items were labeled as correlates because of the difficulty in specifying the exact causal relationship of these variables with commitment. The six correlates examined were motivation, job involvement, stress, occupational commitment, union commitment, and job satisfaction. Internal and overall motivation had the highest correlation with commitment ($r = .668$ & $.563$ respectively), followed by job involvement ($r = .432$), and occupational commitment ($r = .420$). These were all in the positive direction. Stress ($r = -.330$) had a moderate negative relationship with organizational commitment and the relationship between union commitment and organizational commitment was moderately positive ($r = .236$). Finally, overall job satisfaction exhibited a strong positive correlation ($r = .53$) with commitment. Components of satisfaction (as commonly measure by the JDI and Minnesota satisfaction

index) exhibited a range of positive correlations (satisfaction with the work itself, $r = .59$, satisfaction with supervision, coworkers, $r = .409$, coworkers, $r = .348$, promotion, $r = .392$, and pay, $r = .323$). Clearly, satisfaction has a relationship with organizational commitment even though the causal direction of the relationship was not settled in this article (Mathieu & Zajac, 1990).

Job performance and withdrawal behaviors were examined as consequences of organizational commitment. The specific withdrawal behaviors considered were: attendance, lateness, turnover, intention to search for job alternatives, intention to leave one's job, and the perception of job alternatives. Intention to search for job alternatives ($r = -.599$) showed the strongest relationship with organizational commitment, followed by the intention to leave one's job ($r = -.464$). Attendance ($r = .102$), lateness ($r = -.116$), and turnover ($r = -.277$) each exhibited small positive correlations with commitment. Perceptions of job alternatives did not show a significant relationship with commitment. The strong correlation for the intention to search for alternatives but the small correlation for actual turnover can be explained that while an employee wants to leave his or her job (intention to leave one's job) and does search for alternative employment (intention to search for alternatives), there may be no alternatives available, hence preventing turnover (Mathieu & Zajac, 1990).

The prevention of turnover is not the only reason for an organization to consider the commitment of its employees. Higher levels of organizational commitment have also been shown to have an effect on the performance of organizational citizenship behavior by employees. By definition, organizational citizenship behavior is "individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and in the aggregate promotes the effective functioning on the organization (Organ, 1988)." Schappe

(1998) studied three possible predictors of organizational citizenship behavior: procedural justice, job satisfaction, and organizational commitment. Of all of these measures only organizational commitment significantly correlated with organizational citizenship behavior. Further, when a hierarchical regression analysis was performed, only organizational commitment account for unique variance in organizational citizenship behavior ($R^2 = .071$).

Citizenship behavior is considered a contextual type of performance. When Mathieu and Zajac (1990) analyzed the relationship between commitment and job performance in their meta-analysis, the resulting correlations were weak ($r = .135$ for ratings of performance by others and $r = .054$ for performance criteria measures). This is similar to the average correlation of .19 found by Kinicki et. al. (2002) between job satisfaction and performance. Instead of having a direct effect on an employee's performance, it appears that commitment affects contextual types of behaviors that an employee would perform.

Summary

This section gave a brief overview of the literature on organizational commitment. It considered the definition of organizational commitment and possible antecedents and consequences. Generally, organizational commitment is defined as "the relative strength of an individual's identification with and involvement in a particular organization" (Mowday, Steers, and Porter, 1979, p. 226). This definition has been expanded to include different types of commitment such as affective, continuance, and normative commitment (Allen & Meyer, 1990) or attitudinal and calculated commitment (Mathieu & Zajac, 1990).

Studies of the antecedents of organizational commitment show that the strongest relationships are with perceived confidence of the employee in their job and job scope (the amount of skill variety, task identity, task significance, autonomy, and feedback in a person's

job). Other variables, which positively affect organizational commitment, are leadership style, position, organizational tenure, and age. Education showed a negative relationship with commitment, possibly suggesting that more educated individuals have more job opportunities available to them and therefore are less committed to their current place of employment. Other variables have been shown to correlate with organizational commitment, however, their exact causal relationship has not been completely determined. These were motivation, job involvement, stress, occupational commitment, union commitment, and job satisfaction. For consequences of organizational commitment, the strongest relationships were with the intention to search for job alternatives and the intention to leave one's job. Subsequent job performance had a weak relationship with commitment, rather the stronger relationship was with contextual performance (Mathieu & Zajac, 1990).

Industry-university research centers are a small part of the larger university setting. Therefore, faculty commitment to the center is commitment at the sub-organizational level rather than the organizational level. Lok & Crawford (2001) found that subculture was a more important predictor of organizational commitment than the larger organizational culture. This might be true as well for center faculty as the characteristics of the research center might be more important in predicting commitment to the center than the characteristics of the university.

The Relationship between Job Satisfaction and Organizational Commitment

As discussed briefly above, job satisfaction and organizational commitment appear to be related to one another. A comparison the antecedents, correlates, and predictors of the Kinicki et. al. (2002) meta-analysis of the JDI and the meta-analysis of organizational commitment by Mathieu and Zajac (1990) showed a strong relationship between the two

concepts. Kinicki et. al. (2002) found moderately positive correlations between organizational commitment and the five job satisfaction facets of the JDI (pay, $r = .29$, promotion, $r = .35$, coworkers, $r = .34$, work itself, $r = .50$, and supervision, $r = .35$). Mathieu and Zajac (1990) found a significant correlation of .53 between the two variables. Neither of these studies specified a causal direction between job satisfaction and organizational commitment. However, Kacmar, Carlson, & Brymer (1999) found a positive significant path coefficient of .63 for the effect of job satisfaction on organizational commitment (as measured by the OCQ).

A number of studies have looked more closely at this relationship, to determine the causal order of the two constructs. The results of these studies appear to be mixed between no support for a specific causal relationship between job satisfaction and organizational commitment (Cramer, 1996; Martin & Bennet, 1996) and support for a relationship in which organizational commitment is predicted by job satisfaction (Yoon & Thye, 2002).

In a longitudinal study of professional employees at a British engineering company that spanned 13 months ($n = 295$), Cramer (1996) found no temporal causal relationship between job satisfaction at time one and organizational commitment at time two. When both variables were measured at the same point time (for example the relationship between job satisfaction at time one and organizational commitment at time one), there was a significant positive correlation between the two variables ($r = .35$, $p < .001$). This suggests that while there is a causal relationship between the two variables, organizational commitment is a product of an employee's present appraisal of their job and not based on past appraisals.

Martin and Bennett (1996) tested three possible models of the relationship between job satisfaction and organizational commitment using multiple regression; job satisfaction is

antecedent to organizational commitment, organizational commitment is antecedent to job satisfaction, and there is a reciprocal relationship between the two variables. Data were collected from a financial services company ($n = 1,337$). Organizational commitment was measured using items from scales of identification and internalization; satisfaction was measured as four factors: satisfaction with pay, appraisal, benefits, and work conditions. Procedural and distributive justice were also measured and controlled for in the regression analysis. The results showed no support for a causal model between job satisfaction and organizational commitment, suggesting that they are independent constructs. However, the variables were significantly correlated with one another ($r = .31, .23, .30, \text{ and } .40$ for pay, appraisal, benefits, and work conditions respectively). This would suggest that there is in fact a relationship. The authors suggest that it is really procedural and distributive justice that has the direct relationship with commitment and that many previous studies have included measures of these constructs in their measure of job satisfaction and organizational commitment. Still, the significant correlations between the two constructs from this study would still suggest that they are not independent from one another.

Yoon & Thye (2002) tested a more comprehensive model of organizational commitment. In this model, job satisfaction and organizational support (defined in this research as the employee's beliefs that the organization values their contributions and is concerned about their well-being) mediated the relationship between the exogenous variables (job characteristics, organizational related variables, and controls and covariates) and organizational commitment (as measured by the OCQ). Both job satisfaction and organizational support had direct effects on organizational commitment. To validate the model, data was collected from two large organizations in Korea ($n = 2,443$). Analyses were

done via structural equation modeling. Results showed support for the model. Eighty-seven percent of the impact of the exogenous variables on organizational commitment was mediated through either job satisfaction or organizational support. Of this percentage, 51% was mediated through job satisfaction and 36% was mediated through organizational support. Overall, the model explained 51% of the variance in organizational commitment. Job satisfaction had a significant positive direct effect on organizational commitment ($B = .36, p < .001$).

Summary and Study Objectives

In spite of the large amount of research on industry-university relationships, only a small amount of research on the faculty member side of this relationship exists. The three major topics that emerge from this body of research are: the attitudes of faculty towards industry-university collaboration, the characteristics of the faculty and the universities involved, and the outcomes for the university and faculty member involved in this type of relationship.

In general, academic faculty are supportive of industry-university collaboration in research. This support has also shown an increase in the past decade, particularly from the engineering and applied science fields (Lee, 1996). Academic faculty are also open-minded towards changes in the university norms that would facilitate an increase in the amount of collaboration with industry (Campbell, 1997; Campbell & Slaughter, 1999). Rahm (1994) showed that faculty involved in industry-university collaboration tend to come from universities that are “firm friendly” and have a research program that is described as multidisciplinary. Lee (2000) studied motivators for faculty to become involved in industry-university research and their perceived benefits. There was also a strong correlation between

the motivation to participate in research with industry and the benefits received. The limited literature in this area shows a clear need for more research on faculty and industry-university collaboration. The majority of it is descriptive in nature. There is a need for more predictive studies. One study of this type, Meagher (2002), found that variables at different organizational levels (university, center, and individual) were predicative of faculty member's satisfaction with IURCs.

Faculty are an important part of IURCs. However, their decision to become involved in a center is entirely voluntary. A center's success is dependent on both the recruitment and retention of top-notch faculty. Therefore knowing what contributes to a faculty member's satisfaction and ultimately retention should be a high priority for center management. A model, based on the High Performance Cycle (Locke & Latham, 1990) in which the receipt of rewards influences satisfaction with the center, which in turn influences commitment appears to provide a useful framework for thinking about the interrelationship of these constructs.

A review of the literatures on rewards, job satisfaction, and organizational commitment showed general support for the relationships proposed in the model. However, some adjustments will need to be made to the model in order for it to be applicable to the phenomenon of faculty involvement in research centers. First, a faculty member's center involvement is only a part of their job, therefore satisfaction needs to be at the role level rather than at the higher job level. Second, IURCs exist at the sub-organizational level, so organizational commitment needs to be considered at the sub organizational level as well. Finally, a few additional variables need to be added to the model based on the review of the literature.

Faculty involved in IURCs can receive many intrinsic and extrinsic rewards from their center involvement. On the intrinsic side, faculty can feel that conducting research in the center is challenging and they can gain a feeling of accomplishment from seeing results come from the research. In terms of extrinsic rewards, there is receipt of funds to do research and support graduate students. There is also the possibility of obtaining additional research funds through contract work with industry. Besides funding, there is the opportunity to interact with other researchers and gain access to equipment. These two rewards were the strongest predictors of satisfaction in Meagher (2002).

While the focus of this study is not a faculty member's entire job but rather a subset of their job, the job satisfaction literature still mentions a number of variables that may contribute to the satisfaction of faculty member's involvement with IURCs. First, the characteristics of actual jobs that the faculty performs in the center, in this case conducting research, will have an impact on satisfaction. Second the environment in which the faculty works will affect satisfaction, including both the research facilities and the colleagues he or she works with. Next, the amount of funding that is received for center research will have an impact. Finally, the administration of the center can have a positive or negative effect on center satisfaction.

Organizational commitment is defined as "the relative strength of an individual's identification with and involvement in a particular organization" (Mowday, Steers, and Porter, 1979, p. 226). There are three components to this commitment: a strong belief in and acceptance of the organization's goals and values, a willingness to exert effort on behalf of the organization, and a strong desire to maintain membership in the organization. These components would apply to faculty in the IURC as well. However, in this study commitment

is at the sub-organizational level. Commitment at this level may be more important to consider than that of the larger university as the culture of the center is closer in proximity and may have a more immediate effect than the culture of the university. Lok and Crawford (2001) found that culture at the sub organizational level was a more important predictor of commitment than the larger organizational culture.

There are three additional concepts that need to be added to the model based on the review of the literature. The first of these is leadership, in this case the center director impacting a faculty member's commitment to the center. In some studies leaders that showed a consideration style of leadership had a more positive effect on commitment than those who showed a an initiating structure style (Lok & Crawford, 2001). Balfour and Weschler (1996) found a positive effect of supervision on organizational commitment. Finally, in a meta-analysis, Mathieu and Zajac (1990) found that leader communication and a participatory leadership style exhibited moderately positive correlations with commitment.

The second concept that needs to be added to the model is the perception of alternative funding sources. Organizational commitment has shown a stronger relationship with the intention to search for alternatives than for actual turnover (Mathieu & Zajac, 1990). It may be that a search for alternative employment produces no viable options for the employee, hence the employee is forced to stay with the organization. This may apply in a center context as well, as there may or may not be alternative funding sources for the faculty member in their particular field of interest. This might moderate the relationship between satisfaction and commitment. That is, faculty who have few alternative sources of funding may show a stronger relationship between satisfaction and commitment. Faculty who have many different possible sources from which to obtain funding might be very satisfied with

their involvement in the center but not especially committed. The relationship between commitment and retention cognitions could also be moderated by perception of alternatives such that for faculty with many alternative funding sources there is a stronger negative relationship between commitment to the center and thought about leaving the center.

Third, faculty member characteristics need to be considered. Meagher (2002) found that characteristics of the faculty member predicted faculty satisfaction with IURCs. Important characteristics to examine are the number of years that a faculty member has been involved in a center and the amount of funding that each faculty member has. More funding would allow the faculty member to conduct research more efficiently and provide a greater amount of support to graduate students.

Finally, the outcome variables of performance and retention, need to be addressed. The literature describes a weak relationship between satisfaction and performance as well as commitment and performance. Instead it is suggested that contextual performance such as organizational citizenship behaviors are more strongly predicted from satisfaction and commitment. However, the literature suggests a moderately strong positive relationship between satisfaction and retention and commitment and retention. These relationships are stronger for cognitions an employee may have about leaving their job than actual turnover. Therefore, for this study, the outcome variable of performance will be replaced with retention cognitions.

The purpose of the proposed study will be to take a closer look at the concepts of satisfaction and organizational commitment as they pertain to faculty involved in industry-university research centers. A revised model for the study is presented in Figure 3. In addition to the variables in the original model, organizational, leadership, and the perception

of alternative funding sources are added. Finally, performance has been replaced with retention cognitions.

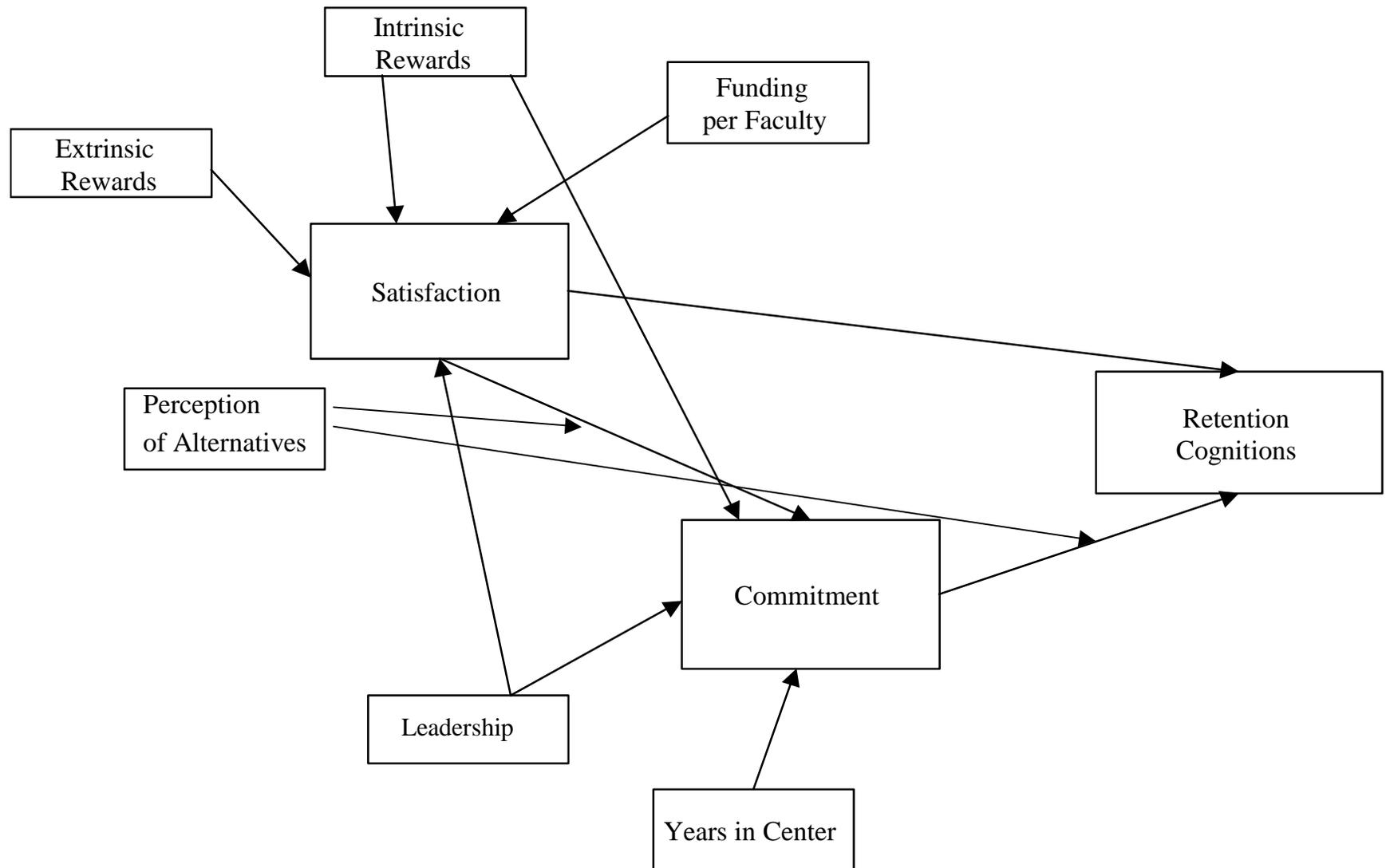


Figure 3: Revised Model

METHOD

Research Objectives and Hypotheses

The objectives of the proposed study are:

1. To evaluate the psychometric properties of modified scales of organizational commitment, job satisfaction and rewards for faculty involved in industry-university research centers.
2. To test a multivariate causal model of satisfaction and commitment for center faculty based on the High Performance Cycle of Locke and Latham (1990).

Hypotheses:

1. A model containing the following exogenous latent constructs: extrinsic center rewards, intrinsic center rewards, the amount of research funding provided by the center to the faculty member, the number of years the faculty member has been involved in the center, and leadership versatility of the center director and the following endogenous latent constructs: center/role satisfaction (referred to as “satisfaction”), center/role commitment (referred to as “commitment”), and retention cognitions will show significant level of fit with center faculty. Satisfaction, center commitment and retention cognitions are the dependent variables in the model.

More Specifically:

2. Intrinsic and extrinsic center rewards from the research center will have a significant positive relationship with center satisfaction.
3. Intrinsic center rewards will have a significant positive relationship with center commitment.

4. Center funding per faculty member will have a significant positive relationship with center satisfaction.
5. Years of center involvement will have a significant positive effect on center commitment.
6. Center satisfaction will have a significant positive relationship with center commitment.
7. A versatile leadership style will have a significant relationship with center commitment and center satisfaction.
8. Center satisfaction and center commitment will have a significant positive effect on retention cognitions.
9. Perception of alternative funding sources will moderate the relationship between satisfaction and center commitment such that there will be a stronger relationship between the two variables for faculty with fewer alternative funding sources.
10. Perception of alternative funding sources will moderate the relationship between center commitment and retention cognitions such that there will be a stronger relationship between the two variables for faculty with many alternative funding sources.

Research Design

The research design is a cross sectional predictive analysis of a national data set of faculty involved in industry-university research centers in US universities.

Setting and Population

The focus of the present study is on the industry–university research center. According to the typology of Koester and Gray (1990), it would be described as a semi-

autonomous, adaptive organization that exists at the university for the purposes of research and product/process development. Industry-university research centers (IURCs) address a wide range of research issues for a number of industry and government sponsors. The basic structure of the IURC is an administrative core at the university that supports and coordinates interrelated research projects involving faculty, students, and staff from multiple disciplines (Gray, Johnson, & Gidley, 1987). Industry funding is provided by industry “sponsors” who pay an annual membership fee. IURC’s are diverse in the type of research they do, their size, and mission. The specific characteristics of the center depend on the scientific discipline and industries the center is affiliated with (Cohen, Florida, and Goe, 1994).

There are many IURCs in the US, which are funded through a number of different programs. One particular program is the National Science Foundation (NSF) Industry-University Cooperative Research Center (IUCRC). The IUCRC is a research center located in a university setting that brings together academic faculty and various industries to collaborate on cutting-edge research in various fields. While each individual center may vary slightly in terms of organizational structure most centers consist of an administrative core, faculty members, and industry affiliates. The majority of the research conducted in the centers is focused on strategic fundamental science issues (versus basic science issues) (Gray & Walters, 1998).

A typical research center will be affiliated with the program for a period of five years. During this time, NSF will supply the center with a small amount of funding and industry members will pay a membership fee to belong to the center. At the end of the five years, the center may continue to be a part of the NSF IUCRC however the amount of funding received from NSF is reduced. The membership fee paid by industry members is used to fund

research in the center. Members have the opportunity to voice the research projects they would like to see funded in the center through the presentation of research proposals at center meetings. The “industrial advisory board”, which consists of an industry representative from each of the member industries vote to determine which projects will be funded (Gray & Walters, 1998)

A required component of each research center is a center evaluator who oversees the evaluation of both the industry members and center researchers. The evaluator collects data on the structure, processes, and outcomes of the center and shares this information with the center director in order to improve center operations. This evaluation occurs every fiscal year that the center is in operation and is a member of the IUCRC program. Results from the industry data collection are included in a detailed evaluator’s report of the center each year. Faculty data is not typically included in this report; rather, it is aggregated with faculty responses from other centers to create a national report that summarizes the data (Gray & Walters, 1998).

During the 2002-2003 academic year, there were a total of 44 centers in the IUCRC program, representing approximately 91 universities from across the United States. A total of 459 faculty were involved in these centers. In the 2003-2004 academic year, there are a total of 46 centers involved in the program and approximately 524 faculty.

Procedures

Data were collected from Industry-University Cooperative Research Centers located at major universities throughout the US. The procedure for data collection varied slightly from the normal evaluation procedure. Instead of each evaluator collecting data at his or her own center, data were collected via a web survey (housed at North Carolina State

University). The evaluator for each center was contacted to determine if they were interested in having their center faculty participate in the study. A total of 34 centers agreed to participate. The evaluator for each participating center submitted an email list of all of the faculty members in his or her center. The email addresses of directors were removed from the lists because a leadership measure was used in the survey. Before the invitation letter from NCSU was sent to each faculty member, evaluators sent out a “heads up” email to their center faculty to alert them that this year’s survey was going to be conducted via the Internet and to expect an email shortly from the evaluation team at NCSU. Approximately two days after the heads up email was sent to faculty, the initial survey email was sent. The email explained the purpose of the study and gave the faculty member the link to the web survey if they wished to participate. Upon completion of the survey, the faculty member was directed to a site that thanked them for their participation and offered them the chance to remove their name and email from any future follow ups for the study. The email information was not linked to the survey responses in any way. Survey responses were coded only by center, individual identification numbers were not used.

Approximately two weeks after the initial survey email was sent out, a reminder email was sent out to faculty. The reminder was sent to all faculty who had not asked that their name be removed from future follow-ups (either from completion of the survey or via a direct email to the NCSU evaluation team asking for their name to be removed).

Approximately one week after the first reminder was sent out, a second reminder email was sent to faculty. The third and final email reminder was sent one week after the second reminder. This reminder was sent out from the IUCRC Program Director at NSF. When

data collection was complete, reports summarizing each center's results and the overall national results were emailed to each evaluator.

Additional data were collected from two centers in the National Science Foundation's Science and Technology (STC) center's program. The center director for each center was contacted and invited to have their center participate. Email address lists of faculty were obtained from the center administrative assistant. Heads up emails were not sent to faculty for these centers. For one of the centers, the initial survey email was sent out directly from the NCSU evaluation team. For the second center, the initial survey email was sent out from the center director. One center received a reminder email approximately two weeks after the initial survey email. The second center did not receive a reminder email due to time limitations.

The response rate for the IUCRC sample was 44.50% (174 out of 391 faculty). For the STC sample, the response rate was 29.06% (25 out of 86 faculty). The overall response rate for the study was 41.72% (199 out of 477 faculty). Table 1 summarizes the sample and response rate for the study.

Table 1

Response Rates for the Study

	Centers	Surveyed Faculty	Sample Received	Response Rate (%)
IUCRC Sample	34	391	174	44.50
STC Sample	2	86	24	29.06
Total Sample	36	477	199	41.72

Comparison of IUCRC and STC Samples

Analyses of Variance were performed to determine if the sample of faculty from the IUCRC sample (N=162) was significantly different from the sample of faculty from the STC sample (N=22) in any of the model variables. Of the 8 comparisons made, 2 were significant, both with the rewards scales. In both cases, the mean for the IUCRC sample was higher than the mean for the STC sample (intrinsic: IUCRC= 3.41, STC= 2.88; $F=7.49$, $p<.01$; extrinsic: IUCRC= 2.86, STC=2.42; $F=5.15$, $p<.05$). In terms of demographics, the IUCRC sample had slightly more full professors than the STC sample (48.4% vs. 38.1% respectively) and the STC had slightly more assistant professors than the IUCRC sample (38.1% vs. 21.6% respectively). These differences will be discussed further in the discussion section. Data for the two samples was combined for the analysis.

Measures

A copy of the web survey is located in Appendix A. Figure 4 shows the overall path model for the study.

Rewards

There are two categories of rewards a faculty member can receive from the center: intrinsic rewards and extrinsic rewards (Mottaz, 1988). A rationally created IUCRC rewards scale was used for the study. Intrinsic rewards are rewards that originate from an internal source, in this case the faculty researcher. Intrinsic rewards were measured with the following items; *the feeling of accomplishment I get from the center research, the amount of challenge I get from conducting center research, and the feeling of satisfaction I get from knowing I am making a contribution to technological development*. Extrinsic rewards are rewards that originate from a source external to the person, in this case from the research

center environment. Extrinsic rewards were measured with the following items; *the recognition I receive for the work I do, chances for promotion, tenure, and/or salary increases, opportunities for consulting, opportunities for research contracts/grants, access to useful equipment, and the ability to support graduate students*. All items were answered on a five point Likert scale with a score of 1 meaning “no impact”, a score of 3 meaning “moderately positive impact”, and a score of 5 meaning “extremely positive impact”. Figure 4 shows the proposed factor structure of the rewards items.

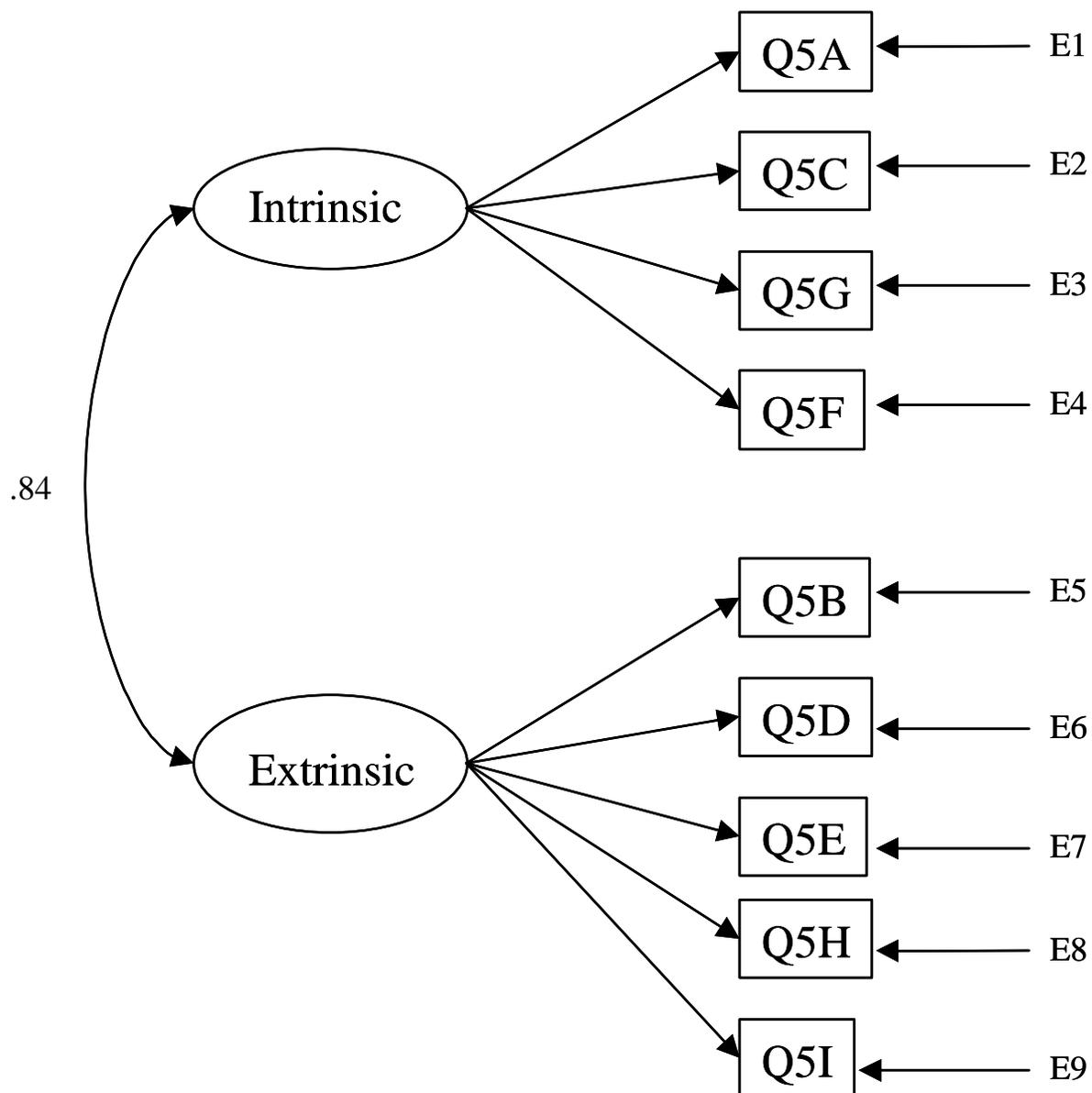


Figure 4: Rewards Factor Structure

Satisfaction

As mentioned in the literature review, a faculty member's involvement in an IURC is only part of their overall job. Therefore, the focus of this study is not on job satisfaction per

se but rather role satisfaction as IUCRC participation is a subset of their job. Therefore, a scale tailored to this population was created.

The standard measures of job satisfaction, like the Job Descriptive Index, focus on different facets of satisfaction; in other words, they focus on things such as the satisfaction with co-workers, supervisors, pay, promotion, and the work itself. In addition, many researchers have created their own satisfaction scales. When measuring overall job satisfaction, some researchers simply averaged the different facet scores on one of the established measures or create their own scales. Other researchers have simply asked one question concerning overall job satisfaction (e.g. “How would you rate your overall satisfaction with the job?”) This has created the issue of whether a scale measure or a single item measure is a more accurate predictor of overall job satisfaction.

Satisfaction in this study is defined as the extent to which people like or dislike their jobs (Spector, 1997). In this case, the focus is on a portion of the faculty member’s job, their involvement in an IURC. The items address the many aspects of this involvement. Specifically, the items asked the faculty members level of satisfaction with: *the quality of the research program, the relevance of the research program to my needs, center administration and operations, amount of funding I receive for conducting research, amount of autonomy I have in conducting research, interaction with faculty and student researchers, interactions with industry members, the significance of the work we are doing, the facilities and equipment, how supportive the center is in helping me achieve my goals, the quality of industrial research.* All of these items were answered on a five point Likert scale with a score of one meaning “not satisfied”, and score of three meaning “somewhat satisfied”, and a score of five meaning “very satisfied”. Figure 5 shows the factor structure of satisfaction.

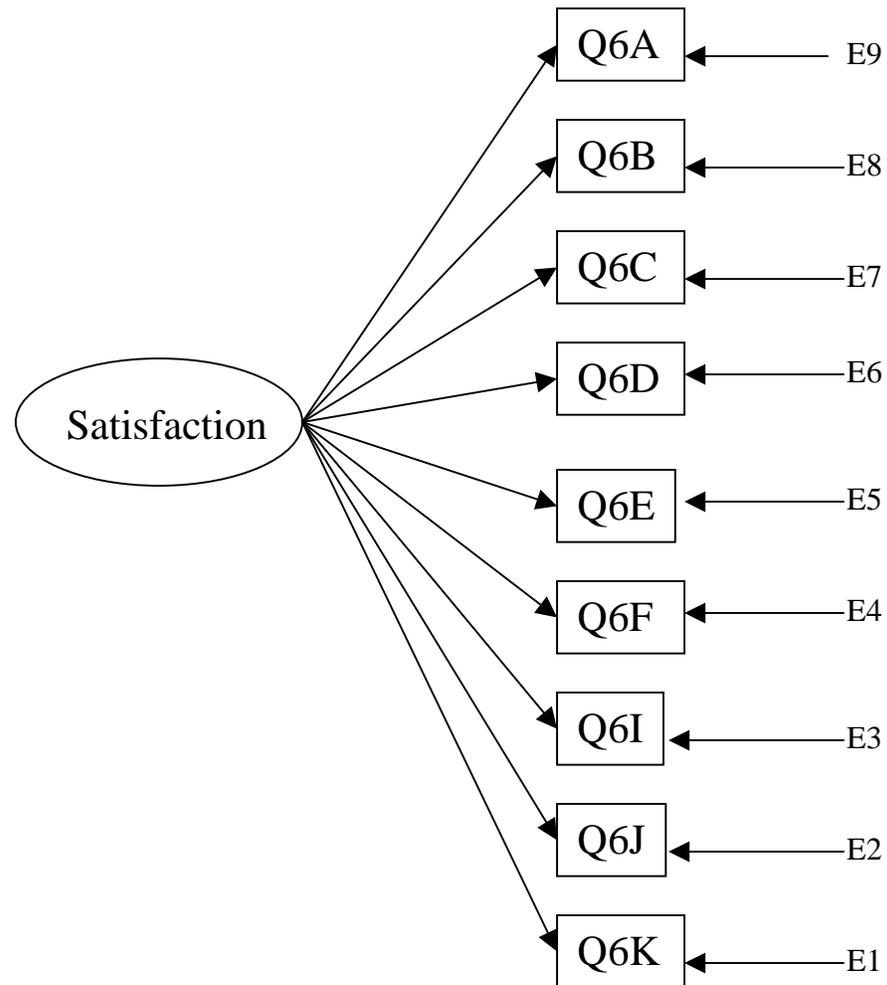


Figure 5: Satisfaction Factor Structure

Commitment and Retention Cognitions

As with satisfaction, the commitment construct in this study is focused at the sub-organizational level. The most commonly used questionnaire focused on organizational commitment is the Organizational Commitment Questionnaire (OCQ) developed by Mowday, Steers, and Porter (1979). It consists of 15 questions, answered on a Likert scale. Six of those questions are reversed scored. The questionnaire was developed to represent the three aspects of the author's definition of organizational commitment: belief in the

organization's goals, willingness to exert effort, and a strong desire to maintain membership. The questionnaire items were intended to only load on one factor, representing a unified measure of organizational commitment.

Using a large sample of employees ($n = 2,563$), from nine different work organizations and a variety of occupations (public sector, university, hospital, bank, telephone company, scientists and engineers, auto company managers, psychiatric technicians, and retail management trainees) the author's tested the survey's reliability, convergent, and discriminant validity. Overall, the coefficient alpha for the survey for each of the samples was good, ranging from .82 to .93. The authors concluded that factor analyses "generally resulted in a single-factor solution" (p.232), although the results for these analyses are not shown in the article. Convergent validity was shown by correlating the questionnaire results with other construct measures implicit in the definition of organizational commitment. First, a survey of organizational attachment was used, the resulting correlations ranged from .63 to .74, depending on the sample. Correlations were also calculated between the scale scores and measures of intention to leave the organization. These correlations ranged from -.31 to -.63. Correlations for measures of intrinsic motivation and the motivation force to perform ranged from .35 to .45. Discriminant validity was determined by examining the correlations with other attitudes measures. The correlation between organizational commitment and job involvement ranged from .30 to .56; with career satisfaction from .39 to .40, and with measures of the Job Descriptive Index, the median correlation was .41. Therefore, while the questionnaire showed a good level of convergent validity, the level of discriminant validity of the OCQ is questionable (Mowday, Steers, & Porter, 1979).

The authors also mention that a shorter version of the OCQ can be used by simply eliminating the six negatively worded items in the survey. However, since all of the analyses were based on the 15 item version of the questionnaire, it is not known whether shorter versions would show the same level of reliability, convergent, or discriminant validity (Mowday, Steers, & Porter, 1979).

In recent years, the validity of the OCQ has come into question, particularly in terms of its factor structure. The author's original intent was for the instrument to contain one factor, giving a unified measure of organizational commitment. However, other researchers have found that a two-factor structure is a better fit for the OCQ. Cook (1997) found a two-factor solution for the OCQ. In a survey of air traffic controllers, 4 possible factor models of the OCQ and cognitions about withdrawal (measured as intention to leave the organization) were tested. The results showed that a two-factor solution of the OCQ fit the data best, with the positive worded items loading onto one factor, and the negatively worded items loading onto another factor. The author concluded that the OCQ is not a uni-dimensional scale and further examination of its factor structure is warranted.

A recent study by Bozeman and Perrewé (2001) addressed whether this factor structure was due to the existence of a second construct or response bias in the OCQ. It has been assumed by most researchers that the six negatively worded items represented turnover intentions and their removal would eliminate possible confounding with any type of turnover measure that may be used in a study. Carmines and Zeller (1979) suggest wording bias may produce a two-factor solution in what is supposed to be a uni-dimensional commitment scale. They suggest that the two-factor solution may be due to general tendencies for respondents to answer a question in a certain manner. In other words, respondents would be likely to answer

positively worded questions in a positive manner and negatively worded questions in a negative manner. This would create higher correlations between each of the like worded items and hence would influence the factor structure of the scale.

Instead, Bozeman and Perrewé (2001) found that not all of the negatively worded items represented retention items and likewise not all of the positively worded items represented commitment. Subject matter experts ($n = 25$) in the area of organizational commitment and its relationship with turnover intentions were asked to select which items in the OCQ they felt represented measures of turnover intentions. The experts identified a mix of positive and negatively worded items as representing turnover intention measures (items 4, 7, 9, 11, 14, and 15). A factor analysis was done with the items from the OCQ combined with items from a measure of cognitions about turnover. If the OCQ was truly a uni-dimensional measure, all of the OCQ items should load onto one factor and the cognitions about turnover survey items should load on a separate factor. Instead, it was found that some of the OCQ items that had been flagged as turnover intention items loaded both on a factor of organizational commitment and a factor with the cognitions about turnover measure, others loaded only on the cognitions about turnover factor and one item did not significantly load onto either factor. The authors recommend that when a research project is using both the OCQ and a measure of turnover that the retention cognition items from the OCQ be eliminated. (Bozeman & Perrewé, 2001).

Since I will not be using a separate measure of retention in this study, both the organizational commitment and retention cognition scales of the OCQ were used. Research has shown that satisfaction and commitment are predictors of retention cognitions (Kinicki et al., 2002; Mathieu & Zajac, 1990). Retention of faculty in IURCs is an important

outcome of satisfaction and commitment. Due to the need to keep the survey for the study as short as possible, each scale was abbreviated. Items were selected by examining the factor analyses in Bozeman and Perrewé (2001). The items with the lowest loadings on each of the two factors (commitment and retention cognitions) were eliminated. Five items on the commitment scale were eliminated and two items on the retention scale were eliminated to yield a four-item scale for each factor. The wording of each item was also adjusted to fit the center context. These eight items were: *I talk about this center with my colleagues as a great place to do research, I find that my values and the center's are very similar, I am proud to tell others I am a part of this center, this center really inspires the very best in me in the way of doing research* (commitment items), *it would take very little change in my present circumstances to cause me to leave this center, there's not much to be gained by sticking with this center indefinitely, for me, this is the best of all possible funding opportunities for which to do research, deciding to do research with this organization was a definite mistake on my part* (retention items). Respondents are asked to rate their level of agreement with seven statements on a seven point Likert Scale with a score of one meaning strongly disagree, a score of four meaning neither agree or disagree, and a score of seven meaning strongly agree. Figure 6 shows the proposed factor structure of the commitment and retention cognitions items.

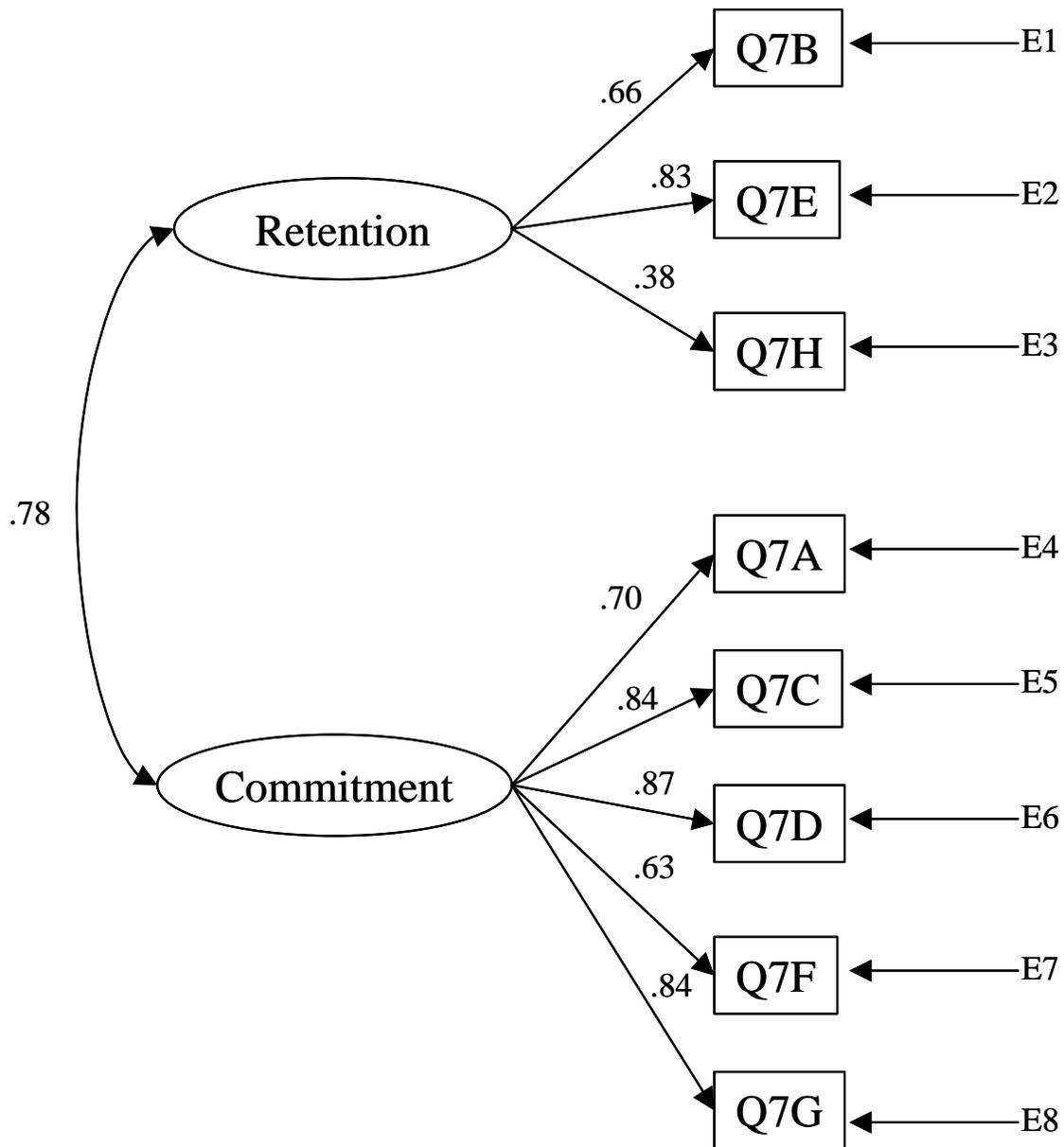


Figure 6: Commitment and Retention Cognitions Factor Structure

Leadership

Research has shown a positive relationship between a consideration style of leadership and organizational commitment (Lok & Crawford, 2001). Also the degree of leader communication and a participatory leadership style exhibited moderately positive correlations with commitment (Mathieu & Zajac, 1990). These types of leadership allow for

more participation of the employee and a great degree of give and take between the employee and the leader. The center director of an IUCRC serves an important leadership role.

Faculty members are recruited by the center director and they oversee the major operations of the research center. Therefore, a faculty member's opinion of the center director could have a profound effect on their level of commitment to the center.

The Forceful-Enabling Scale from the Leadership Versatility Index (Kaiser & Kaplan, 2002) addresses two types of leadership: forceful and enabling. Forceful leadership involves taking charge and being direct. It is synonymous with an initiating structure type of leadership. Enabling leadership involves empowerment and being open to input. It is synonymous with a consideration style of leadership. The authors of the index believe that leaders possess both of these types of leadership, however, usually one type becomes more dominant. A truly versatile leader will be able assess the situation and exhibit the type of leadership that would be most effective at that time. The forceful-enabling scale is designed to measure this versatility. Respondents answer on an eight point Likert type scale whether the leader possess too much, not enough, or just the right amount of each quality. The full scale consists of sixteen item pairs; each pair has a forceful and enabling item. Participants score the degree to which the leader displays each of the behaviors in the model. Scores range from too little to just the right amount to too much. In addition to scores on both the forceful and enabling scales, an overall versatility score is also calculated. This score represents the extent to which the leader is able to assess the situation and display the appropriate forceful or enabling behaviors that are needed.

Due to space and time considerations, the scale was shortened. One of the authors of the scale was contacted for permission to use the scale. The author offered to examine his

baseline data to determine three pairs of items, which would show the best psychometric properties. Those items were; *steps in – gets involved when problems arise (f)*; *trusts people to handle problems that come up in their area of responsibility (e)*; *lets people know clearly where he/she stands on issues – declares him/herself (f)*; *interested in where other people stand on issues- receptive to their ideas (e)*; *pushes people hard (f)*; *provides emotional support – offers encouragement (e)*. The shortened scale showed an overall reliability of .74 with the baseline data (which is a sample of 917 ratings of 107 managers and executives). The scales also showed a correlation of .92 with the full 16-item scale (Kaiser & Kaplan, 2002). The versatility scale was used in the model analysis.

Perception of Alternatives

The meta-analysis by Mathieu & Zajac (1990) showed that the intention to search for alternatives has a stronger relationship with commitment than actual turnover ($r = -.599$ for intention to search for alternatives vs. $r = -.280$ for turnover). One reason for this may be that while an employee intends to leave his or her job, the search for alternatives does not produce employment that would be equal to or better than the present job. This may apply to faculty as well in terms of grant funding. Center participation provides a source of grant funding for their research. Alternative funding sources may not be available to them, making commitment to the center greater. Perceptions of alternative funding sources was measured with a single item. Faculty members were asked to rate the *likelihood of finding alternative funding for the research that they do in the center*. This rating was done on a four point Likert scale with an answer of one indicating “not likely” and a score of four indicating “extremely likely”.

Demographics

The following demographics were measured.

Years in the center. The number of years that the faculty member has been involved in the center. Faculty who have more time invested in the center may be more committed than newer center faculty.

Center funding per faculty member. Faculty were asked to specify the amount of money they receive from the center for their research. This was measured in \$25,000 increments.

Gender. The faculty member indicated their gender.

Academic rank. The faculty member was asked what their current rank was. The choices of responses was assistant professor, associate professor, full professor, or other rank.

Tenure status. Whether or not the faculty member is tenured. If he or she is not tenured, a second question asked whether he or she is in a tenure track position.

Data Analysis

The data were first examined for missing data. If a case contained more than two missing items on a scale, the case was deleted. For scales that contained only three items, if two or more items were missing, the case was deleted. This resulted in the deletion of 15 cases. For those cases missing only one or two items in a scale (one item for the three item scales) the mean for that scale for that case was calculated using the answers for the remaining items on that scale. A total of 184 cases were used in these analyses described below.

Preliminary EFA's were run for the rewards variables to aid in determining scale structure. Negative items on the OCQ were reversed scored. CFA's were run for the rewards, satisfaction, and commitment (retention) scale. Reliabilities were run for the

rewards, satisfaction, commitment, and retention scales. Because of the proprietary nature of the scale, the leadership data was scored by the scale author and returned to the researcher. The scale author also ran reliabilities for this scale. Scale scores were created for rewards, satisfaction, commitment, and retention.

The STC sub-sample was compared to the data for the IUCRC sample to ensure that there were no major differences in responses. ANOVAs were run comparing the scale means for the IUCRC sample and the STC sample.

Finally, a path analysis model was run to determine the fit of the proposed model to the data. This method was employed rather than a full structural equation model due to the small sample size. Factor analyses were run separately from the rest of the model. Scale scores were created for each of the measures and these scale scores were used in the path analysis. This reduced the number of parameters to be estimated in the model and allowed for a smaller sample size. Figure 7 shows the overall path model for the study. First, the model was run for the entire sample. Then, to determine whether there was a significant effect for the proposed moderator, the sample was divided into two groups based on their response to the perception of funding alternatives question. Those who answered a 1 or 2 indicating that it was not very likely that they would be able to find alternative funding sources for the work they do in the center were put into one group. Those who answered a 3 or 4 indicating that it is somewhat or very likely that they could find alternative funding sources for the research they do in the center were put into another group. A model was run for each group and differences in the satisfaction-commitment relationship were examined.

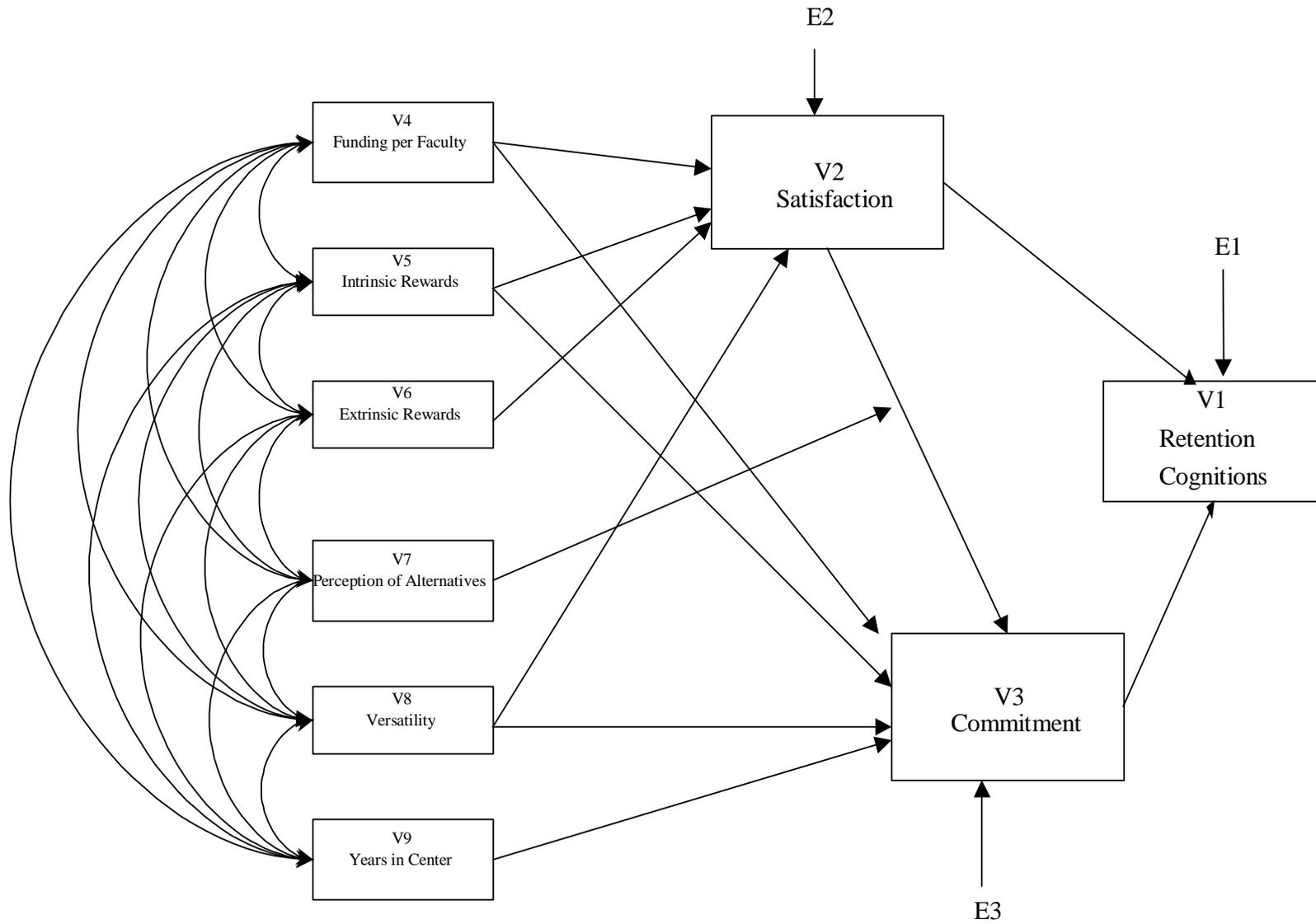


Figure 7: Overall Path Model

RESULTS

Demographics

Table 2 summarizes the demographic characteristics of the whole sample. The majority of the sample was male (83.5%) and from public universities (93.2%). In terms of academic rank, just under half of the faculty in the sample were full professors (47.2%) and there were about equal percentages of associate (22.7%) and assistant (21.6%) professors. The remainder of the sample listed their academic rank as “other” (8.5%). This included non-tenure academic positions such as adjunct professor, research associate, and research scientist. Sixty percent of the sample were tenured faculty, with the remaining either tenure track (15.2%), or non-tenured (23.9%). The faculty have been involved with the center an average of 5.29 years ($M= 5.29$, $SD=4.14$) and receive approximately \$50,000 in research funding for center research ($M=2.96$, $SD = 2.99$; this variable was measured in increments of \$25,000).

Data Transformations

Skewness and kurtosis were examined for the variables in the model that were not going to be part of a scale. A result showed that the amount of funding that faculty received for center research was heavily skewed to the right (skewness = 3.58), therefore the variable was transformed by taking its natural log. The resulting logged variable showed low skewness (skewness = .38).

Leadership Versatility

The leadership versatility measure was scored by the author of the scale. Reliabilities and descriptive statistics were also calculated. The scale showed an overall reliability of .92. The mean rating of leadership versatility was 85% with a standard deviation of 23%.

Table 2

Demographic Characteristics of the Sample

Characteristic	N	%
Gender		
Male	152	83.5
Female	30	16.5
University Type		
Public	164	93.2
Private	12	6.8
Rank		
Assistant Professor	38	21.6
Associate Professor	40	22.7
Full Professor	83	47.2
Other	15	8.5
Tenure Status		
Tenured	110	59.8
Tenure Track	44	23.9
Non-Tenure Track	28	15.2

Confirmatory Factor AnalysesRewards

Figure 8 shows the factor structure for rewards and the standardized path loadings for each of the two factors. The Chi Square for the model was significant ($X^2 = 55.17$, $p < .001$, $df = 26$), indicating inadequate fit. However, Hatcher (1994) cautions that the Chi-Square test should not be used as a strict statistical test but rather as one of many goodness of fit indices for determining the adequacy of a model. This is because the Chi Square can be

influenced by factors other than the adequacy of the model such as sample size, multivariate normality, etc. Looking at other fit indices, both the normed fit index and the comparative fit index values were above .9 (NFI= .93, CFI= .96), the value considered acceptable to determine the data has an appropriate level of fit to the proposed model. Also, the Root Mean Square Error of Approximation (RMSEA), was within the acceptable range for adequate fit (below .08) (RMSEA=.078). Therefore, it was determined that the data showed an adequate fit to the model.

Reliabilities were calculated for each of the factors. Intrinsic rewards (alpha= .87) showed a higher reliability than extrinsic rewards (alpha = .76). Scale scores were calculated for each respondent for intrinsic and extrinsic rewards by averaging the items in each scale. The intrinsic rewards scale had a mean of 3.34 and a standard deviation of .88. The extrinsic rewards scale had a mean of 2.81 and a standard deviation of .86 (Both factors were measured on a 5 point scale). These means indicate that on average faculty feel that center participation had a greater impact on their receipt of intrinsic rewards versus their receipt of extrinsic rewards.

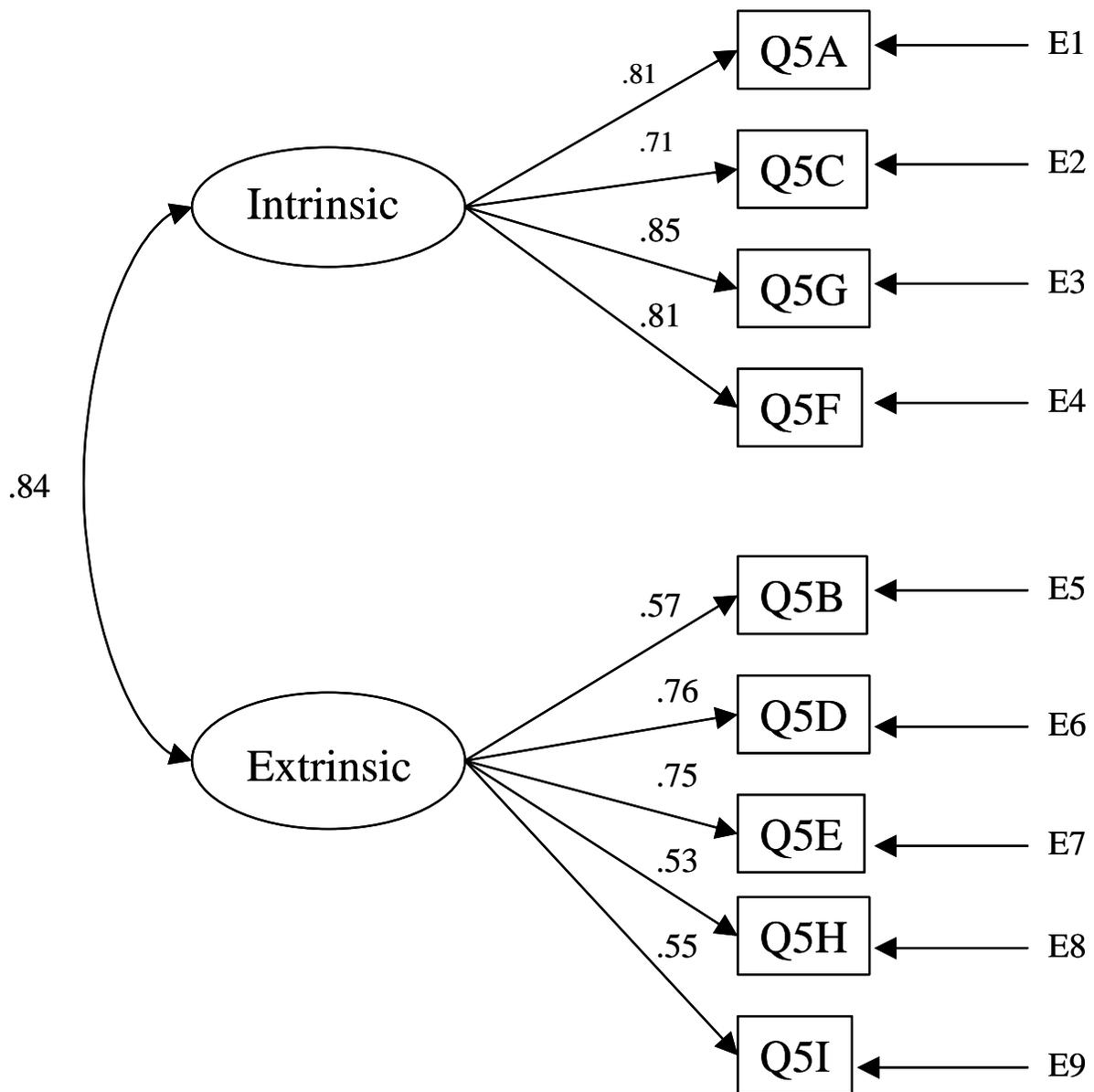


Figure 8: Confirmatory Factor Analysis for Rewards (Standardized Path Coefficients)

Satisfaction

While cleaning the data, it was discovered that two of the satisfaction items were coded incorrectly in the creation of the web survey (interactions with faculty and student researchers, and the significance of the work we are doing). These two items were coded as being the same item number as two items in the commitment scale. Since the satisfaction items appeared first in the survey, when the respondent answered the items in the commitment scale, the answers to the satisfaction items were erased. The miscoding resulted in the loss of data for those two satisfaction items. Fortunately, this was the longest scale in the questionnaire at 11 items. The resulting satisfaction scale contained 9 items.

The results for the confirmatory factor analysis for satisfaction is presented in Figure 9. It was proposed that all of the items would load onto one factor. Results for the analysis show support for this proposal. Again, as with the reward factors, the Chi Square for the analysis was significant ($X^2=58.67$, $p<.00$, $df=27$) however, both the NFI and CFI showed an acceptable level of fit (NFI=.93, CFI=.96). The RMSEA was also just within acceptable levels (RMSEA=.08). Therefore, it was determined that the data showed an adequate fit to the model. Figure 6 shows the factor structure for satisfaction and the standardized path loading for this factor.

A reliability score was calculated for the factor. The overall reliability was .89. Scale scores were calculated for each respondent for satisfaction by averaging the items in each scale. The scale had a mean of 3.58 and a standard deviation of .76 (measured on a 5 point scale). Overall, faculty are satisfied with their center involvement.

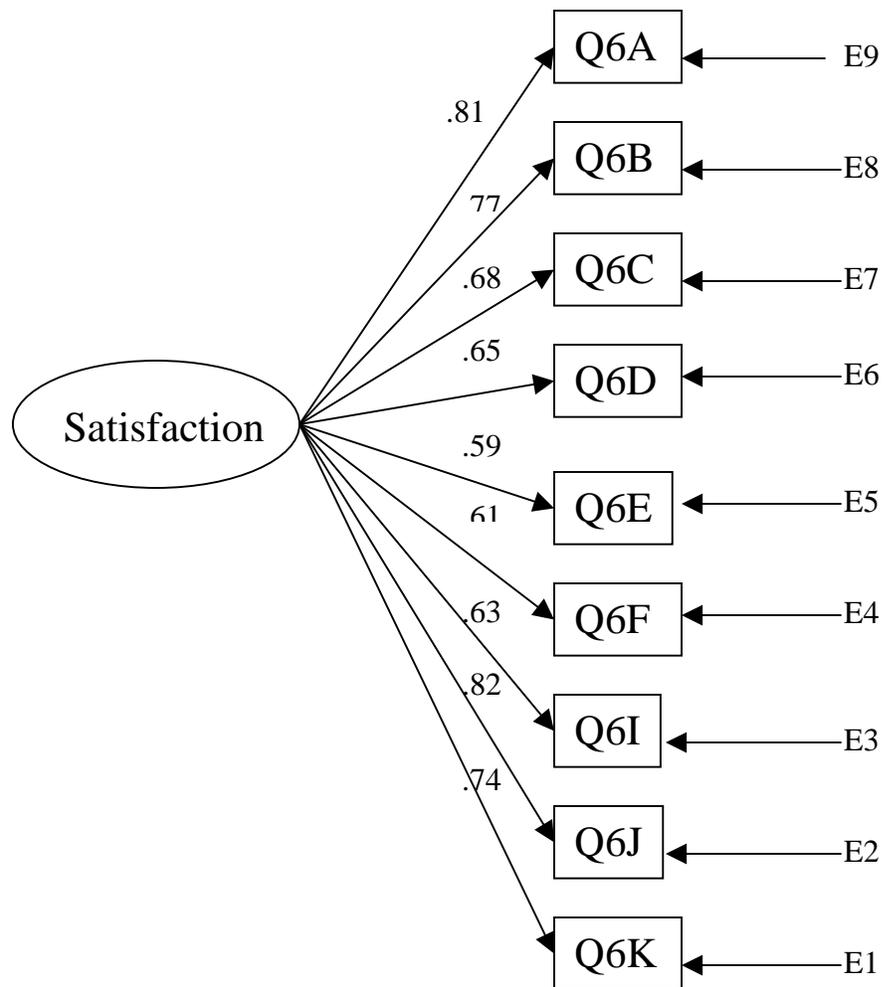


Figure 9: Confirmatory Factor Analysis for Satisfaction (Standardized Path Coefficients)

Commitment and Retention Cognitions

The items from the Organizational Commitment Questionnaire were hypothesized to form two factors. One factor, called commitment would contain the following items: *I find that my values and the center's are very similar, this center really inspires the very best in me in doing research, I am proud to tell others I am a part of this center, for me this is the best of all possible funding opportunities for which to do research, I talk about this center with my colleagues as a great place to do research.* The second factor, called retention

cognitions, would contain the following items: *it would take very little in my present circumstances to cause me to leave this center, there's not much to be gained by sticking with this center for the foreseeable future, and deciding to do research with this organization was a definite mistake on my part.* The retention cognition items were reverse scored before factor analyses were conducted. The results showed support for this model. Again the Chi-Square was significant ($X^2= 41.44$, $p<.01$) however, the NFI and CFI both showed good levels of fit (NFI=.95, CFI=.97). The RMSEA was just at the point of acceptability (RMSEA=.08). Therefore it was concluded that the data showed an acceptable level of fit to the model. Figure 10 shows the proposed model and the path coefficients for each item.

Reliabilities were calculated for each of the factors. Commitment (alpha= .88) showed a higher reliability than retention cognitions (alpha = .73). Scale scores were calculated for each respondent for commitment and retention cognitions by averaging the items in each scale. The commitment scale had a mean of 5.06 (on a seven point scale) and a standard deviation of 1.31. The retention cognitions scale had a mean of 5.84 (on a seven point scale) and a standard deviation of 1.29. These results show that faculty are fairly committed to their research centers and they intend to remain in the organization.

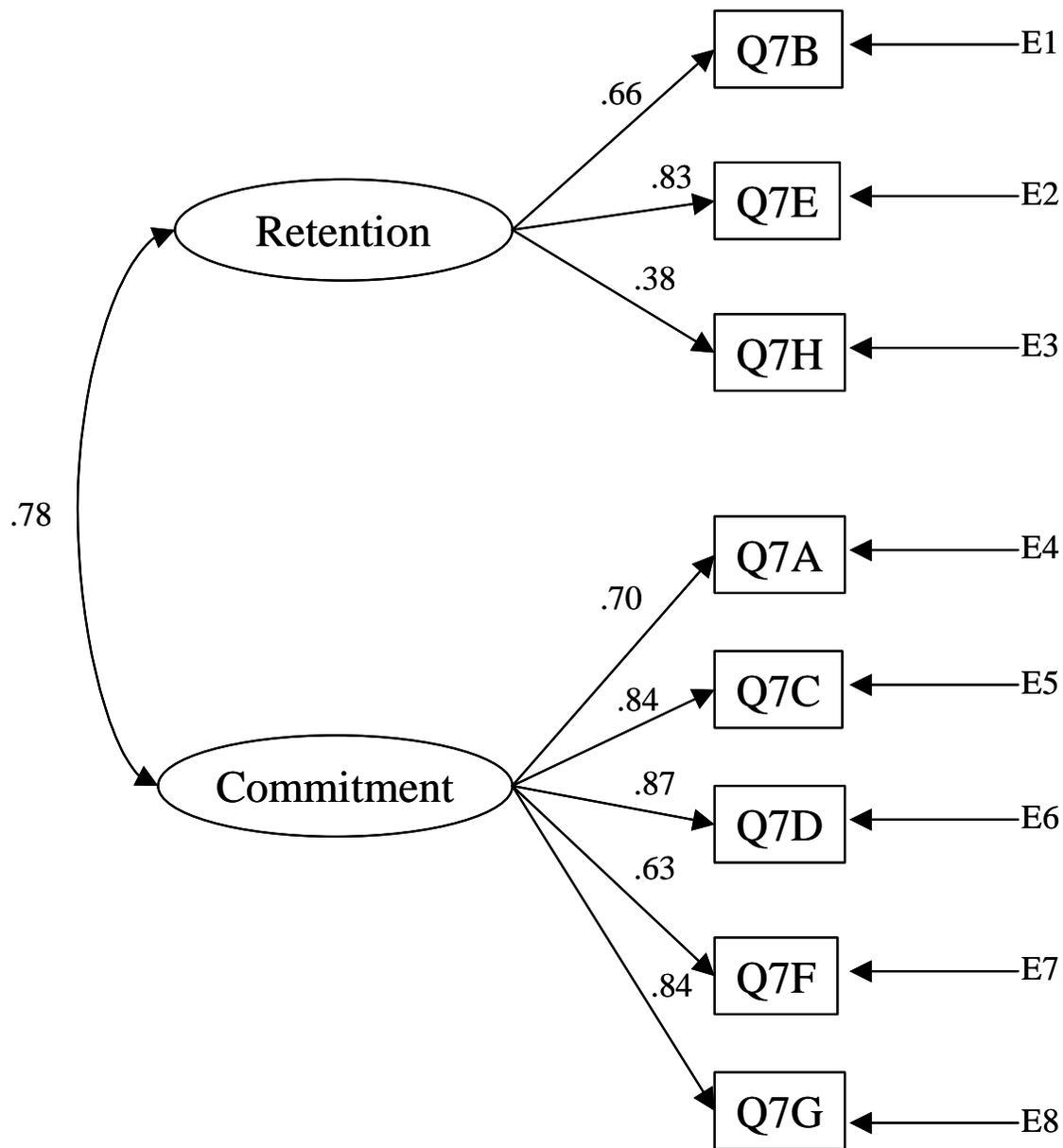


Figure 10: Confirmatory Factor Analysis for Commitment and Retention Cognitions

Path Analysis

The proposed model (see Figure 7) was tested using path analysis. First, the model was run for the whole sample, without consideration of the moderator of perception of alternatives. The Chi square was insignificant, indicating that the model showed an acceptable level of fit to the data ($X^2=13.84$, $p=.054$, $df=7$). The normed fit index and the comparative fit index were also within the acceptable range for a well fitting model (NFI=.98, CFI=.99). Finally, the RMSEA was also within the acceptable range for a well fitting model (RMSEA=.07). Therefore, it was concluded that the data shows an acceptable fit to the model. Figure 11 shows the model with the path loadings. In terms of variance explained in the endogenous variables (satisfaction, commitment, and retention cognitions), the model explained 58.7% of the variance in satisfaction, 67.4% of the variance in commitment, and 43.4% of the variance in retention cognitions.

The core model, that the receipt of rewards would lead to satisfaction, which would lead to commitment, and ultimately retention cognitions was supported, all of the relationships in this path were significant. Both intrinsic and extrinsic rewards significantly predicted satisfaction. The standardized regression weight was larger for the effect of intrinsic rewards on satisfaction than extrinsic rewards on satisfaction, although this difference was not significant ($t=.64$, $df=172$, $p>.05$). Intrinsic rewards had a significant direct effect on commitment and a significant mediating effect through satisfaction. The direct effect of satisfaction on commitment was the strongest path loading of all the relationships proposed in the model. Finally, commitment was a significant predictor of retention cognitions. Satisfaction also predicted retention, however, the relationship was stronger for commitment. Leadership did not have a significant direct effect on commitment

as hypothesized but did have a significant direct effect on satisfaction. Finally, the amount of funding a faculty member receives had a significant direct effect on satisfaction.

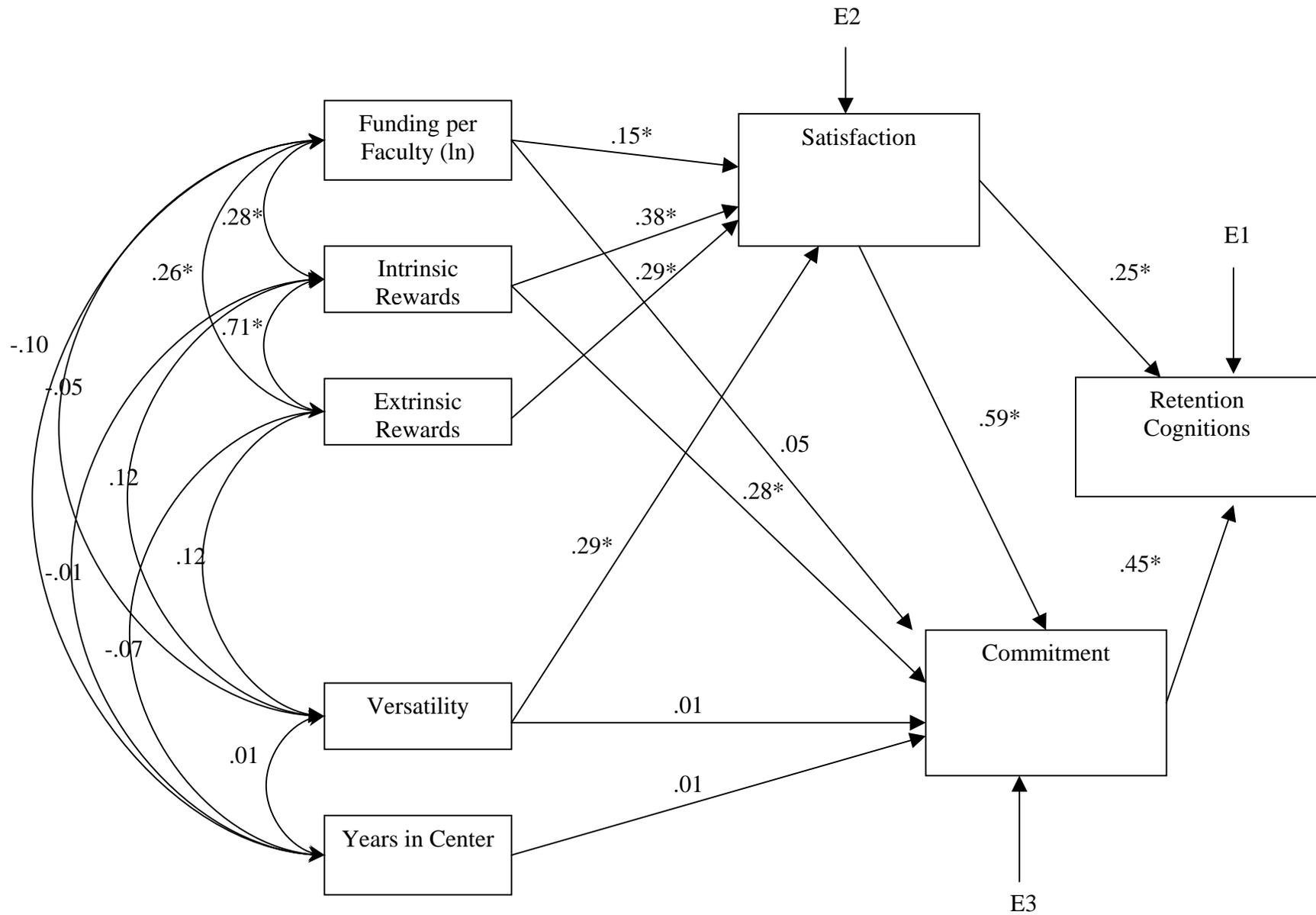


Figure 11: Overall Path Model (Standardized path loadings, *=p<.05)

Moderation by perception of alternatives

The effect of perception alternatives as a moderator was tested in two places in the model. The first test was to see if the variable moderated the relationship between satisfaction and commitment. The second test was to see if the variable moderated the relationship between commitment and retention cognitions. A multiple group analysis was conducted to test these relationships. The sample was divided into two groups based on each respondent's indication of whether they felt it would be likely to find alternative funding for the research they do in the center. The first group of faculty were those respondents who indicated it would be either "not likely" or "somewhat likely" that they could find alternative funding. The second group consisted of those respondents who indicated it would be either "very likely" or "extremely likely" to find alternative funding. To test whether the effect of the proposed moderator was significant, four different analyses were run, for each analysis the Chi-square was examined. The first analysis allowed any of the proposed relationships to be different for each of the groups ($X^2=16.9$, $df=14$). The second analysis allowed only the path from satisfaction to commitment to be different between the two groups; all other relationships were constrained ($X^2=61.5$, $df=50$). The third analysis allowed only the path from commitment to retention cognitions to be different between the two groups; all other relationships were constrained ($X^2=64.14$, $df=50$). The fourth analysis constrained all paths in the model between the two groups ($X^2=64.2$, $df=51$). Differences in the Chi-squares were then compared across the unconstrained, mostly constrained, and completely constrained models. If the differences between the Chi-squares were significant, the effect of a moderator would be suggested. Across all four analyses, none

of the Chi-square difference tests were significant. Thus it can be concluded that there is no significant moderating effect in the model due to the perception of alternative funding sources.

Exploratory Analyses

An exploratory analysis was conducted to see if there was a difference in the model between faculty who were more productive than faculty who were less productive in their center research. First, correlations between the productivity variables of number of publications, number of presentations, and number of theses and dissertations and the model variables of satisfaction, commitment, and retention were examined. The results are presented in Table 4. The results showed few significant correlations between the productivity variables and satisfaction and the productivity variables and commitment. However, there were a number of significant correlations between the productivity variables and commitment. Commitment was positively correlated with the number of center publications ($r=.16, p<.05$), the number of center presentations ($r=.18, p<.05$), and the number of theses and dissertation in progress ($r=.21, p<.01$). These variables suggest that faculty who are more committed to the center tend to have higher numbers of publications and presentations based on center research, and are involved in more theses and dissertations than those that are based on non-center research. Commitment was also significantly correlated with the same variables for research that is outside of the center, however, these variables were in the opposite direction ($r=-.24, p<.01$, for publications; $r=-.23, p<.01$, for presentations, and $r=-.23, p<.01$ for theses and dissertations). These results suggest that faculty who are more committed to the center have less publications

and presentations outside of the center and are involved in less theses and dissertations involving non-center related research.

Table 3

Correlations for Productivity Variables and Model Variables of Satisfaction, Commitment and Retention

	Satisfaction	Commitment	Retention
Center Publications	.04	.16*	.06
Non-center Publications	-.14	-.24**	-.14
Center Presentations	.09	.18*	.09
Non-center Presentations	-.24**	-.23**	-.13
Center Theses/Dissertations Completed	.06	.09	-.05
Non-center Theses/Dissertations Completed	.02	-.06	.00
Center Theses/Dissertations Still in Progress	.18*	.21**	.14
Non-center Theses/Dissertations Still in Progress	-.13	-.23**	-.27**

Note: *p<.05, **p<.01

An index variable was computed which contained the following variables: number of publications and presentations, number of theses and dissertations (completed and still in progress), number of intellectual property events, and level of funding received for research. All of the variables pertained center research. The index variable was created by standardizing each of the above items into a Z-score. Next, the scores for each of the items were added up to obtain an overall “best faculty” measure for center research. Two groups were created based on the center research index variable, the first group contained those faculty who were at or below the mean value (M=.01), the second group contained those faculty who were above the mean value. As with the test for the

perceptions of alternatives moderator, a multiple group analysis was conducted to see if there was a moderating effect for the center research index variable on any of the relationships in the model. Two analyses were run, and the Chi-squares were compared across the analyses. The first analysis allowed any of the variables in the model to differ between each group ($X^2=121.73$, $df=40$). The second analysis constrained all of the paths to be equal across each group ($X^2=131.79$, $df=51$). If the difference between the two Chi-squares is significant, differences in the model between each of the groups would be suggested. The difference between the two Chi-squares was not significant, indicating that there are no differences in the model for more productive versus less productive faculty.

A correlational analysis was conducted to determine if there were any additional relationships in the model that could be explored in future research that were not hypothesized. Table 5 shows these results. The perception of alternatives was negatively correlated with commitment ($r=-.17$, $p<.05$) suggesting the possibility of a main effect instead of a the hypothesized moderating effect.

Table 5

Correlational Analysis

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Amount of funding (ln)									
2. Perception of Alternatives	.03								
3. Leader versatility	-.05	-.12							
4. Years in center	.09	.04	.01						
5. Intrinsic Rewards	.30**	-.06	.12	-.01					
6. Extrinsic Rewards	.26**	.02	.12	-.07	.71**				
7. Satisfaction	.32**	-.11	.37**	-.05	.66**	.63**			
8. Commitment	.32**	-.17*	.25**	-.02	.68**	.64**	.79**		
9. Retention Cognitions	.22**	-.14	.29**	.05	.40**	.34**	.60**	.64**	
10. Center productivity	.59**	.08	.05	.33**	.15*	.17*	.15*	.22**	.12

Note: * = $p < .05$, ** = $p < .01$

DISCUSSION

While there is a large amount of literature on industry-university research relationships, the majority of it is focused on the industry side of the relationship. There is a small but growing body of literature on faculty and I/U. Faculty are an important part of industry-university research centers. In fact the success of the center is dependent on the recruitment and retention of top-notch faculty in the center's area of research. However, since faculty have choices about where they conduct their research, their decision to become involved in a center is primarily voluntary. Given the importance of these issues, the purpose of this study was to test a multivariate model of faculty satisfaction and organizational commitment with industry-university research centers.

One of the research objectives was to test the psychometric properties of two new measures; a center rewards measure and a center satisfaction measure, and a modified scale of organizational commitment. The creation of these measures was specifically geared toward the IURC environment. The rewards measure showed an acceptable level of reliability, though improvements could be made to increase the reliability of the extrinsic rewards scale. The commitment and satisfaction measures were slightly higher in reliability. All of these measures showed a good level of predictive ability when placed in the proposed model. These measures are recommended for future use with faculty involved in industry-university research partnerships.

Overall the research shows support for the proposed multivariate model and demonstrates the satisfaction and commitment of faculty in IURCs are important to consider. Rewards were a significant predictor of satisfaction, which in turn was a significant predictor of commitment. This shows support for a part of the High

Performance Cycle (Locke & Latham, 1990). Although the research results of Mottaz (1988) shows that workers place the greatest importance on intrinsic rewards from their work, there was no difference for this sample in size of the effect on satisfaction for intrinsic and extrinsic rewards on satisfaction. However, intrinsic rewards had both a direct and indirect effect on commitment. The natural log of the level of funding that a faculty member receives for their research also had a significant direct effect on satisfaction. This is in contrast to an earlier study on the same population in which funding per faculty member was not a significant predictor of satisfaction (Meagher, 2002). However, significant improvements were made in both the measure of funding and the satisfaction measure. The results of this study suggest that faculty who receive a greater amount of funding for their research have a higher level of satisfaction than faculty who receive less money for their research.

Contrary to the information in the literature, leadership versatility did not have a direct on commitment as hypothesized but rather, an indirect effect through satisfaction. The results here indicate that faculty who feel that their director is able to assess a particular situation and display the appropriate amount and type of a particular behavior (either forceful or enabling) are more satisfied. A simpler way to word this is to say that more versatile leaders tend to have more satisfied faculty.

The strongest relationship in the model was between job satisfaction and organizational commitment, giving support to a causal relationship from job satisfaction to commitment. The effect size of .59 is between the size of the results obtained by Yoon & Thye (2002) and Kacmar, Carlson & Brymer (1999). Both satisfaction and commitment had a significant direct effect on retention cognitions. The relationship was

stronger for commitment than for satisfaction, this could possibly be because the commitment and retention scales from the same measure (OCQ). These results exemplify the importance of faculty satisfaction with their center involvement, as it has both a direct effect on their thoughts about staying or leaving the center and an indirect effect on retention cognitions via commitment.

This model showed an improvement from previous models in terms of the variance explained in satisfaction and commitment. Fraser and Hodge (2000) explained 52.3% of the variance in satisfaction, in a study focused on the job satisfaction of faculty. This model explained a slightly higher percentage of the variance in satisfaction (58.7%). This could be because satisfaction in this study was focused on a subset of the faculty member's job, rather than on the entire job. Lok and Crawford (2001) focused on organizational commitment at the subculture level and explained 47% of the variance. The model in this study explained 57.4% of the variance in commitment at the sub-organizational level.

The test of the moderator of perception of alternatives on the relationship between satisfaction and commitment was not significant. This suggests that there is no difference between faculty who feel that they have a lot of options available to them for research funding and those who feel they have fewer options in terms of how their satisfaction with their center involvement affects their level of commitment to the center. There also was no significant moderating effect for the perception of alternatives on the relationship between commitment and retention. An exploratory analysis showed a significant negative relationship between perception of alternatives and commitment. It is possible that there is a direct effect of perception of alternatives on commitment. Further, an

exploratory analysis showed that there were no differences in the model between “best” or more productive center faculty and less productive faculty. Given that the literature states that the relationship between satisfaction and performance and commitment and performance is low it might not be all that surprising to find no differences in the model between these two groups.

Data was collected from two centers programs: the NSF Industry-University Cooperative Research Centers Program and the NSF Science and Technology Centers Program. The results of the analysis shows that the two samples are similar with a few exceptions. The overall chi-square for the model showed a slightly better fit for the IUCRC only sample versus the IUCRC and STC sample. As a sample of faculty contain only the IUCRC program participants is more homogeneous (everyone is a part of the same centers program), this is not surprising. The IUCRC center sample scored higher for the measures of intrinsic and extrinsic rewards than the STC center sample. The difference in scores may be due to the fact that faculty in STC centers have less of a direct relationship with industry than faculty in IUCRC centers. The content of both of the rewards scales focused on rewards in terms of the cooperative research relationship with industry. In the multivariate model, the causal relationship between satisfaction and retention was not significant when the STC sample was removed. However, there is still a significant indirect effect with commitment serving as the mediating variable.

Limitations

As with any research, this study is not without its limitations. The first limitation is the response rate. The overall response rate for this study was 41.72%, which while lower than what was hoped for, is still about what is expected in survey research. The

response rate for the IUCRC sample was 44.50%. This is comparable to previous evaluation years for the IUCRC program (2002-2003 response rate was 42.28%). However, since slightly over half of the population did not answer the survey, the results may not generalize to the entire population.

Second, two of the instruments (rewards and satisfaction) used in the survey are brand-new constructs created especially for this study and this population. While the reliabilities were within the acceptable range for research, this is the first administration of these measures. Further validation would be necessary in order to increase some of the reliabilities. Third, the focus of this study was specifically on the I/U research center. It is not clear how these measures would work with other populations involved in I/U research.

Conclusions

The results of this study have important implications for policy in the area of industry-university cooperative research. First, at the center level, there are key conclusions study that can aid center management in improving the functioning of their center. The first is that faculty satisfaction with their involvement in I/U centers is important and should be focused upon by the center administration. A faculty member's level of satisfaction with the center directly influences their level of commitment to the center. Second, the rewards that a faculty member receives, particularly the intrinsic rewards, have an effect on their level of commitment to the research center. Finally, and probably most importantly, their thoughts about remaining involved in the center are directly influenced by both their level of center satisfaction and center commitment.

Center satisfaction and commitment of faculty are affected by a number of factors. Intrinsic and extrinsic rewards such as the level of challenge felt from conducting research affects satisfaction and commitment. Center directors are also key to the satisfaction of faculty; their behavior has a direct effect on satisfaction. More specifically, the director's ability to display "versatile" leadership behavior (i.e. forceful vs. enabling leadership) depending on the situation is important. Finally the amount of research funding affects satisfaction, faculty with a greater amount of research funding are more satisfied with their center involvement.

There are many ways that a center can improve the level of satisfaction (and subsequently the commitment and retention) of their faculty. These action items should be focused on improving the intrinsic and extrinsic rewards that faculty receive. Simply looking at the items in the rewards measure provides a few suggestions. First, centers should work to create a highly stimulating research environment for faculty. Center directors should consistently challenge their faculty to extend and improve their research as much as possible. A part of this challenging environment is the provision of useful resources for conducting research. Second, center directors should recognize faculty accomplishments both via informal methods (i.e. complimenting them on their success in conversations) and formal methods (recognizing success during center meetings). Finally, technological achievements of faculty should be acknowledged in center literature, especially the literature that is disseminated to industry members, the university system, or to potential center members.

Center directors, as leaders and managers of the center, are key people in spearheading the effort towards center improvement. They can also monitor their own

behavior to ensure they are being as versatile as possible in their leadership duties. Management training, possibly provided by the NSF IUCRC program, can aid in this effort. Effective leaders are beneficial at the individual center level but also at the program level as better-managed centers will result in improved research outcomes program wide. In addition to investing in training for its center directors the NSF IUCRC program should pay particular attention in its selection of center directors, being sure that these people possess good leadership potential. Also, at the program level, greater attention needs to be paid to faculty who contribute to the success of the program by the program sponsor.

At the national public policy level, the results of this study show that industry-university research collaboration is beneficial to the university participants as well as the industry participants. Policy makers should make sure that their focus in improving industry-university collaboration is on both sides of the relationship. Failing to understand the faculty role and providing the appropriate support and resources for that role could have a negative impact on faculty participation in the collaboration effort.

Future Directions for Research

While this study added to the literature on faculty and industry-university collaboration, there are still many areas for future research. One area is further expansion and evaluation of the present model, especially with faculty involved in other types of industry-university collaboration such as contract research. It would be interesting to evaluate gender differences in the model or to examine faculty who are involved in multi-university centers versus faculty who are involved in single site centers. These comparisons could not be made in the present study due to small sample size.

Another area of research that would be interesting is taking a closer look at center leadership. One of the major finding of this study was that center leadership has a direct effect on faculty member satisfaction. Center directors play a very key role in these research centers, from the creation of the center, to providing the direction of research that the center will take, to the recruitment of center members. A more thorough examination of their role and how it relates to other center participants is needed.

Finally, it may be difficult to predict the actual behavior of faculty from the results of the satisfaction, commitment, and retention cognition scales. For example, it is not definite that a faculty member who has a low level of commitment to the center and who is having thoughts of leaving the center will actually choose to end his or her center involvement. Instead the faculty member could choose to perform the minimum requirements needed to maintain research funding in the center. Clearly further research is needed into predicting the behavioral outcomes of satisfaction and commitment.

The literature review mentioned that while the relationship between satisfaction and performance and commitment and performance is pretty low when core performance is considered, there is some evidence that these relationships are stronger when more contextual performance is taken into consideration. A closer look could be taken into this area in the centers to see what type of contextual performance behaviors (such as organization citizenship behavior) faculty are engaging in and how this behavior relates to their satisfaction and performance.

For the IUCRC evaluation project, further refinement of the survey used in this study needs to be done so that it can be an effective evaluation instrument. A comparison should be made between the previous evaluation survey and the present survey to see

which components are most effective in providing information to evaluators and center directors. A consideration should be made to incorporating some of the new constructs (commitment, leadership, retention cognitions) from the present survey into the previous evaluation survey. Having an effective evaluation survey means that the data obtained is useful to the center. This allows more effective steps to be taken to improve faculty member's experiences with their center involvement, therefore increasing their center satisfaction and commitment.

The results of this study show that faculty satisfaction with their I/U center involvement is important. Having more satisfied faculty means having more committed faculty who intend to remain in the center. This creates a more stable research environment and increases a center's chance to be a driving force in their field of science.

REFERENCES

Allen, N.J. & Meyer, J.P. (1990). The measurement and antecedents of affective, continuance and normative commitment to the organization. Journal of Occupational Psychology, *63*, 1-18.

Balfour, D.L. & Wechsler, B. (1996). Organizational commitment: Antecedents and outcomes in public organizations. Public Productivity & Management Review, *19*, 256-277.

Blumenthal, D., Gluck, M., Louis, K., Stoto, M.A., & Wise, D. (1986). University-industry research relationships in biotechnology: Implications for the university. Science, *232*, 1361-1366.

Blumenthal, D., Campbell, E.G., Causino, N., & Louis, K.S. (1996). Participation of life-science faculty in research relationships with industry. The New England Journal of Medicine, *335*, 1734-1739.

Blumenthal, D., Campbell, E.G., Anderson, M.S., Causino, N., & Louis, K.S. (1997). Withholding research results in academic life science. Journal of the American Medical Association, *277*, 1224-1228.

Bokemeier, J.L. & Lacy, W.B. (1986). Job values, job rewards, and work conditions as factors in job satisfaction among men and women. The Sociological Quarterly, *28*, 189-204.

Bozeman, D.P. & Perrewe, P.L. (2001). The effect of item content overlap on organizational commitment questionnaire-turnover cognition relationships. Journal of Applied Psychology, *86*, 161-173.

Boyd, E.A. & Bero, L.A. (2000). Assessing faculty financial relationships with industry: A case study. Journal of the American Medical Association, 284, 2209-2214.

Campbell, T.I.D. (1997). Public policy for the 21st century: addressing potential conflicts in university-industry collaboration. The Review of Higher Education, 20, 357-379.

Campbell, T.I.D. & Slaughter, S. (1999). Faculty and administrators' attitudes toward potential conflicts of interest commitment, and equity in university-industry relationship. The Journal of Higher Education, 70, 309-352.

Carmines, E.G. & Zeller, R.A. (1979). Reliability and Validity Assessment. Thousand Oaks, CA: Sage Publications, Inc.

Cook, D.K. (1997). Discriminant validity of the organizational commitment questionnaire, Psychological Reports, 80, 431-441.

Cohen, A. & Gattiker, U.E. (1994). Rewards and organizational commitment across structural characteristics: A meta-analysis. Journal of Business and Psychology, 9, 137-157.

Cohen, W., Florida, R., & Goe, R.W. (1994). University-industry research centers in the United States. Carnegie Mellon University.

Cohen, W. M., Nelson, R.R., & Walsh, J.P. (2002). Link and impacts: the influence of public research on industrial R&D. Management Science, 48, 1-23.

Cramer, D. (1996). Job satisfaction and organizational continuance commitment: A two-wave panel study. Journal of Organizational Behavior, 17, 389-400.

Feller, I (1999). Technology transfer from universities. In: Smart, J.C. (Ed.) Higher Education: Handbook of Theory and Research. New York, NY: Agathon Press.

Fernandez, J. & Mateo, M.A. (1993). The development and factorial validation of the academic setting evaluation questionnaire. Educational and Psychological Measurement, 53, 425-435.

Fraser, J. & Hodge, M. (2000). Job satisfaction in higher education: examining gender in professional work settings. Sociological Inquiry, 70, 172-187.

Gosling, S.D., Vazire, S., Srivastava, S., & John, O.P. (2004). Should we trust web-based studies? A comparative analysis of six preconceptions about Internet questionnaires. American Psychologist, 59, 93-104.

Gray, D.O. (2000). Cooperative research: Government-sponsored industry-university cooperative research: An analysis of cooperative research center evaluation approaches. Research Evaluation, 8, 57-67.

Gray, D.O., Johnson, E.C., & Gidley, T.R. (1986). Industry-university projects and centers. Evaluation Review, 10, 776-793.

Gray, D.O. & Walters, S.G. (Eds.) (1998). Managing the Industry/University Cooperative Research Center: A Guide for Directors and Other Stakeholders. Columbus, OH: Battelle Press.

Hackman, J.R., Oldham, G., Janson, R., & Purdy, K. (1975). A new strategy for job enrichment. In: B.M. Staw (Ed.) (1995). Psychological Dimensions of Organizational Behavior. Upper Saddle River, NJ: Prentice Hall.

Hagedorn, L.S. (1994). Retirement proximity's role in the prediction of satisfaction in academe. Research in Higher Education, 35, 711-728.

Hagedorn, L.S. (2000). Conceptualizing faculty job satisfaction: components, theories, and outcomes. In L.S. Hagedorn (Ed.) What Contributes to Job Satisfaction Among Faculty and Staff. (pp. 5-20). San Francisco, CA: Jossey-Bass.

Hatcher, L.H. (1994). A Step by Step Approach to Using SAS for Factor Analysis and Structural Equation Modeling. Cary, NC: SAS Publishing.

Iaffaldano, M.T. & Muchinsky, P.M. (1985). Job satisfaction and job performance: a meta-analysis. Psychological Bulletin, *97*, 251-273.

Johnson, E.C. & Tornatzky, L.G. (1984). Cooperative science: a national study of university and industry researcher. Unpublished report.

Johnsrud, L.K. & Heck, R.H. (1998). Faculty worklife: Establishing benchmarks across groups. Research in Higher Education, *39*, 539-555.

Kacmar, K.M., Carlson, D.S., & Brymer, R.A. (1999). Antecedents and consequences of organizational commitment: A comparison of two scales. Educational & Psychological Measurement, *59*, 976-994.

Kaiser, R.B. & Kaplan, R.E. (2002). Leadership Versatility Index User's Guide. Greensboro, NC: Kaplan DeVries Inc.

Kaplan, R.E. & Kaiser, R.B. (2002). Leadership Versatility Index. Greensboro, NC: Kaplan DeVries, Inc.

Kinicki, A.J., McKee-Ryan, F.M., Schriesheim, C.A., & Carson, K.P. (2002). Assessing the construct validity of the Job Descriptive Index: a review and meta-analysis. Journal of Applied Psychology, *87*, 14-32.

Koester, N. & Gray, D.O. (1990). A Typology of Industry-University Linking Mechanisms: Implications for Policy and Programs.

Landry, R., Traore, N., & Godin, B. (1996). An econometric analysis of the effect of collaboration on academic research productivity. Higher Education, *32*, 283-301.

Lee, Y.S. (1996). Technology transfer and the research university: A search for the boundaries of university-industry collaboration. Research Policy, *25*, 843-863.

Lee, Y.S. (2000). The sustainability of university-industry research collaboration: An empirical assessment. Journal of Technology Transfer, *25*, 111-123.

Locke, E.A. (1976). The Nature and Causes of Job Satisfaction. In: M.D. Dunnette (Ed.) The Handbook of Industrial and Organizational Psychology. (pp. 1297-1349). Chicago: Rand McNally.

Locke, E.A., Fitzpatrick, W., & White, F.M. (1984). Job satisfaction and role clarity among university and college faculty. In J.L. Bess (Ed.) College and University Organization: Insights from the Behavioral Sciences. (pp. 105-127). New York, NY: NYU Press.

Locke, E.A. & Latham, G.P. (1990). Work motivation and satisfaction: Light at the end of the tunnel. Psychological Science, *1*, 240-246.

Lok, P. & Crawford, J. (2000). Antecedents of organizational commitment and the mediating role of job satisfaction. Journal of Managerial Psychology, *16*, 594-613.

Louis, K.S., Jones, L.M., Anderson, M.S., Blumenthol, D., & Campbell, E.G. (2001). Entrepreneurship, secrecy and productivity: A comparison of clinical and non-clinical life sciences faculty. Journal of Technology Transfer, *26*, 233-245.

Martin, C.L. & Bennett, N. (1996). The role of justice judgments in explaining the relationship between job satisfaction and organizational commitment. Group & Organization Management, *21*, 84-104.

Matier, M.W. (1990). Retaining faculty: a tale of two campuses. Research in Higher Education, 31, 39-60.

Mathieu, J.E. & Zajac, D.M. (1990). A review and meta-analysis of the antecedents, correlates, and consequences of organizational commitment. Psychological Bulletin, 108, 171-194.

Meagher, B.M. (2002). Faculty outcomes from industry-university collaboration. Unpublished Master's Thesis, North Carolina State University.

Mowday, R.T., Steers, R.M., & Porter, L.W. (1979). Measurement of Organizational Commitment, Journal of Vocational Behavior, 14, 224-247.

Mottaz, C.J. (1988). Determinants of organizational commitment. Human Relations, 41, 467-482.

Mottaz, C.J. (1985). The relative importance of intrinsic and extrinsic rewards as determinant of work satisfaction. The Sociological Quarterly, 26, 365-385.

Nagy, M.S. (2002). Using a single item approach to measure facet job satisfaction. Journal of Occupational and Organizational Psychology, 75, 77-86.

National Science Board (2002). Science & Engineering Indicators- 2002. (pp. 4-15 to 4-40; 6-1 to 6-60). Arlington,VA: National Science Foundation.

Oliver, N. (1990). Work rewards, work values, and organizational commitment in an employee-owned firm: Evidence from the U.K. Human Relations, 43, 513-526.

Oliver, N. (1990). Rewards, investments, alternatives, and organizational commitment: Empirical evidence and theoretical development. Journal of Occupational Psychology, 63, 19-31.

- Oshagbemi, T. (1997). Job satisfaction and dissatisfaction in higher education. Education & Training, 39, 354-359.
- Rahm, D. (1994). Academic perceptions of university-firm technology transfer. Policy Studies Journal, 22, 267-278.
- Rahm, K., Kirkland, J., & Bozeman, B. (2000). A description of university-industry R&D collaboration in the US. In: University-Industry R&D Collaboration in the United States, the United Kingdom, and Japan. (pp. 40-58). Boston, MA: Kluwer.\
- Smith, P.C., Kendall, L.M., & Hulin, C.L. (1969). Measurement of Satisfaction in Work and Retirement. Chicago: Rand McNally.
- Spector, P.E. (1997). Job Satisfaction: Application, Assessment, Cause, and Consequences. Thousand Oaks, CA: Sage Publications.
- Strickland, D.E., Kannankutty, N., & Morgan, R.P. (1996). Forging links between engineering education and industry: The research connection. Paper presented at the Meeting of the American Society for Engineering Education, Washington, DC.
- Tang, T.L. & Talpade, M. (1999). Sex differences in satisfaction with pay and co-workers: Faculty and staff at a public institution of higher education. Public Personnel Management, 28, 345-349.
- Yoon, J. & Thye, S.R. (2002). A dual process model of organizational commitment: Job satisfaction and organizational support. Work & Occupations, 29, 97-124.

APPENDIX A



**NATIONAL SCIENCE FOUNDATION
INDUSTRY-UNIVERSITY
COOPERATIVE RESEARCH CENTERS
EVALUATION PROJECT**

Faculty Questionnaire

CENTER:

INSTRUCTIONS: Please answer all questions. For multiple choice questions, please **CIRCLE** the number that corresponds with your response.

PLEASE RETURN BY:

Return to:

Phone:

Fax:

Email:

I YOUR RESEARCH EFFORT

- 1) Compared to the research projects which you typically conduct outside the Center, would you describe your Center-funded research as:

	Much more basic	More basic	Same	More applied	Much more applied
a)	1	2	3	4	5

	Much broader in scope	Broader	Same	Narrower	Much narrower in scope
b)	1	2	3	4	5

	Much longer time frame	Longer	Same	Shorter	Much shorter time frame
c)	1	2	3	4	5

- 2) During the past year:

- a) How many **publications** in the open literature (exclude in press) have you had?
- b) How many **presentations** have you made at conferences or professional meetings?
- c) How many **theses/dissertations** are under your supervision?

Based on Center research	Outside of center research
Number completed during last year	Number still in progress
Based on Center research	Outside of center research
\$ _____ _____,000 (Thousands of dollars)	\$ _____ _____,000 (Thousands of dollars)
1	Not likely
3	Somewhat likely
4	Very likely
5	Extremely likely
Based on Center research	Outside of center research

Completed
Still in Progress

- d) Approximately how much **research funding** did you receive last year? Include direct and indirect funding.

- e) How likely is it that you could **find alternative funding** for the research you do in the center?

3. During the time you have been involved in the center, how many intellectual property events have you been involved with?

Inventions disclosed
Patent applications filed
Patents received

Based on Center research	Outside of center research

- 4) How long, on average, do you feel that it should take for a new Center research project to yield tangible results?

number of months: _____

II INVESTIGATOR REWARDS

- 5) What impact has participation in the Center had for YOU in the following areas?

	No impact	Somewhat positive impact	Moderately positive impact	Very positive impact	Extremely positive impact	
a	The feeling of accomplishment I get from the work I do	1	2	3	4	5
b	Opportunities for consulting	1	2	3	4	5
c	The feeling of satisfaction I get from knowing I am making a contribution to technological development	1	2	3	4	5
d	Opportunities for research contracts/grants	1	2	3	4	5
e	Chances for promotion, tenure, and/or salary increases	1	2	3	4	5
f	The recognition I receive for the work I do	1	2	3	4	5
g	The level of challenge posed by conducting center research	1	2	3	4	5
h	Access to useful equipment	1	2	3	4	5
i	Ability to support graduate students	1	2	3	4	5

III SATISFACTION

- 6) During the past year, how satisfied were you with the following:

	Not Satisfied	Slightly Satisfied	Somewhat satisfied	Quite Satisfied	Very Satisfied	
a	Quality of the research program	1	2	3	4	5
b	Relevance of the research program to my needs	1	2	3	4	5
c	Center administration and operations	1	2	3	4	5
d	Amount of funding I receive for conducting research	1	2	3	4	5
e	Amount of autonomy I have in conducting research	1	2	3	4	5
f	Interactions with industry members	1	2	3	4	5
g	Interactions with faculty and student researchers	1	2	3	4	5
h	The significance of the work we are doing	1	2	3	4	5
i	The facilities and equipment	1	2	3	4	5
j	How supportive the center is in helping me achieve my goals	1	2	3	4	5
k	The quality of industrial research	1	2	3	4	5

IV COMMITMENT

6) Pertaining to your involvement in the center, please rate your level of agreement or disagreement according to the scale below

		Strongly Agree	Disagree	Neither agree or disagree	Agree	Strongly Agree
a	I find that my values and the center's are very similar.	1	2	3	4	5
b	It would take very little change in my present circumstances to cause me to leave this center.	1	2	3	4	5
c	This center really inspires the very best in me in doing research.	1	2	3	4	5
d	I am proud to tell others I am a part of this center.	1	2	3	4	5
e	There's not much to be gained by sticking with this center for the foreseeable future.	1	2	3	4	5
f	For me, this is the best of all possible funding opportunities for which to do research.	1	2	3	4	5
g	I talk about this center with my colleagues as a great place to do research.	1	2	3	4	5
h	Deciding to do research with this organization was a definite mistake on my part.	1	2	3	4	5

V CENTER DIRECTOR

7) Concerning the center director with whom you deal with the most, please rate the degree to which he or she possesses the following qualities:

	Much too little	←		Too Little	Just the right amount	Too much	→		Much too much
a. Steps in – gets personally involved when problems arise	-4	-3	-2	-1	0	1	2	3	4
b. Trusts people to handle problems that come up in their area of responsibility	-4	-3	-2	-1	0	1	2	3	4
c. Lets people know clearly where he/she stands on issues. Declares him/herself	-4	-3	-2	-1	0	1	2	3	4
d. Interested in where other people stand on issues. Receptive to their ideas	-4	-3	-2	-1	0	1	2	3	4
e. Pushes people hard	-4	-3	-2	-1	0	1	2	3	4
f. Provides emotional support. Offers encouragement	-4	-3	-2	-1	0	1	2	3	4

VI BACKGROUND

- 8) What is your gender? Male
 Female
- 9) What is your age? _____years
- 10) How many years have you been involved with the center? _____
- 11) Is your university Public
 Private
- 12) What is your academic rank? Assistant Professor
 Associate Professor
 Full Professor
 Other (please state) : _____
- 13a) Are you tenured? Yes No
- 13b) If NO, are you in a tenure track position? Yes No

THANK YOU FOR YOUR COOPERATION!