

**Addressing goal incongruence in boundary-spanning organizations: structuration
strategies in university-industry research centers**

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Abstract

Government policies in the US have been focused for decades on facilitating boundary-spanning collaborations to facilitate coordinated problem solving. Perhaps nowhere have such attempts been more prevalent than in science and technology policy with the proliferation of multi-discipline, multi-institutional university research centers. As organizations performing knowledge-based, non-routine work, centers typically rate low on the traditional parameters for organizational structure. Yet, the disciplinary and sectoral boundaries spanned by centers assure high levels of goal incongruence, among center faculty and between faculty goals and center goals, respectively. The problem of goal incongruence is exacerbated for centers relying on academic department-based faculty over whom center directors typically exercise no formal personnel authority.

The purpose of this study is to assess the structuration strategies that center directors employ in response to goal incongruence. While these strategies can entail center formalization and differentiation, they also can include reliance on departmental structures, hiring research faculty over whom direct personnel authority may be exercised, as well as a number of socialization tactics. Because so little is known about these strategies, the method of this study is multi-case and qualitative, drawing on documentation and interviews for 21 university research centers drawn from 2 centers programs at the National Science Foundation.

The findings suggest specific patterns – between specific boundary-spanning characteristics and different types of perceived goal incongruence, and between different types of perceived goal incongruence and specific structuration strategies. The findings also suggest that these patterns are interrupted when center directors do not perceive goal incongruence as problematic to achieving center goals. Implications for research and theory as well as for policy and management are discussed.

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1. Introduction

Government policies in the US have been focused for decades on devising new institutions as well as on facilitating less formal modes of collaboration drawing on expertise and other resources from organizational and individual actors spanning multiple boundaries to facilitate coordinated problem solving (Hjern & Porter 1981, Kettl 1993, O'Toole 1993, Provan & Milward 1995, O'Toole & Meier 1999, McGuire 2006). Perhaps nowhere have such attempts been more prevalent than in science and technology policy, as research collaboration across scientific and engineering disciplines, universities, and sectors is now typically required for the creation and application of scientific knowledge and the development of new technologies in the interest of solving problems (Ikenberry & Friedman 1972, Bozeman & Boardman 2003, National Academies of Science 2007, Block & Miller 2008). Amid numerous government policies and initiatives for organizing and incentivizing problem-focused, boundary-spanning research collaboration over the past few decades, the US has seen the proliferation of university research centers focused on generating scientific and technical solutions to problems by organizing expertise from multiple science and engineering disciplines and facilitating interactions between collaborative teams of academic researchers and private companies (Bozeman & Boardman 2003, 2004).

Despite the prevalence of government centers programs for university-based research and development – e.g., at the National Science Foundation (NSF), the National

Institutes of Health (NIH), and, increasingly, at other Federal agencies with strong science and technology components (Boardman & Ponomariov, forthcoming) – there is little understanding of the organizational structures and management practices employed by university research centers for aligning university faculty behaviors with center goals and objectives. One interpretation of this dearth of understanding is that such knowledge would not be useful for decision making, because academic research is self-regulating and, as such, university faculty should be left alone to organize their individual activities as they see fit in the interest of advancing general knowledge which, eventually, will somehow accumulate social and economic impacts (Polanyi 1962).

Yet, university research centers as well as other aspects of contemporary science and technology policy prove this a poor description of the organization and management of contemporary scientific work (Beesley 2003). Centers, at least those sponsored at the Federal and State levels by way of government centers programs, generally constitute explicit institution-building efforts to harness scientific and technical resources and efforts towards specific, predetermined, and problem-focused ends (Bozeman & Boardman 2003, 2004).

Perhaps a better reason not to investigate the structural and management characteristics of university research centers is that centers are exposed, in general, to the same constraints and opportunities for organizing university faculty and will demonstrate little structural and managerial variability. As organizations focused on non-routine, knowledge-intensive work that is not amenable to scientific (Taylorist) management, university research centers are probably universally “low” on the traditional parameters for organizational structure (see Hall & Tolbert 2005 for a review), much as private firms

focused on scientific and technical innovation generally are (see Laursen & Foss 2003 for a review). Organizations focused on scientific and technical innovation typically require input from and collaboration across knowledge workers with expertise in different knowledge areas, which makes it difficult to predict individual contributions to the production process (Schumpeter 1934, Aiken & Hage 1971, Ouchi 1980). Thus, management cannot easily articulate fixed working groups or rules and procedures governing individual behaviors therein, nor can decision making authority easily be assigned (Itoh 1993, Itoh 1994, Laursen 2002).

However, relatively risky or “radical” research and development has been demonstrated to increase formalization and complexity among private firms focused on scientific and technical innovation, while “incremental” research and development has demonstrated to decrease structure in these firms (Ettlie et al. 1984). Because government centers programs vary similarly with the extent to which their scientific and technical goals diverge from or converge with existing knowledge and practice, there is reason to expect variability across center structures and management practices, for instance along programmatic lines. University research centers sponsored by government centers programs emphasizing relatively “transformative” research and development, such as the Engineering Research Centers at the NSF, may prove relatively structured organizationally when compared to centers historically focused on industry assistance by way of “normal science,” such as the Industry/University Cooperative Research Centers, also at the NSF. Results from research on private firms additionally suggest that there may be structural and management variability *within* singular (as well as across different) government centers programs. For instance, size, among other common organizational

parameters, has demonstrated consistently to correlate positively with the structuration of private firms focused on research and development as core functions (Laursen & Foss 2003).

While there is good reason to expect investigation of structures and management practices across university research centers to demonstrate variability, there is also good reason to expect these findings to diverge from extant findings and theory for private firms focused on scientific and technical innovation. Organizations focused on science and technology (or any non-routine, knowledge-based work) generally must compensate for relatively low levels of structure with relatively high levels of what Ouchi (1980) and more recent scholars (e.g., Souitaris 1999, Laursen 2002) drawing on transaction cost economics call “goal congruence” – which in short is the extent to which members of a particular organization have overlapping goals. Without shared or common goals, individual members will pursue their individual objectives and fail to coordinate as a team to accomplish organizational goals (Ouchi 1980, Laursen 2002, Laursen & Foss 2003, Cano & Cano 2006).

University research centers are relatively challenged when it comes to generating goal congruence. Centers draw their faculty predominantly from academic departments, yet have little if any input into departmental tenure and promotion decisions (Bozeman & Boardman 2003). Moreover, the applied and commercially-relevant nature of the research and development conducted by university-industry centers is not always conducive to publications and other outputs valued by academic departments (Geisler 1995), which can produce role conflict for and in some instances shirking by university faculty (Boardman & Bozeman 2007). Thus, while centers are structurally similar to private

firms and other “flat” arrangements focused on scientific and technical innovation, they lack formal personnel authority and, by design (Ikenberry & Friedman 1972), pursue scientific and technical goals and outputs that diverge from the goals and outputs valued by the academic departments from which they draw faculty, making goal congruence much harder to come by (Geisler, 1995, Boardman & Bozeman 2007, Boardman & Ponomariov 2007).

Little is known about how university research centers are responding to this management challenge. While there has been some case study of managerial innovation in singular centers and while some government centers programs document “best practices” for center organization and management, there seem to be more studies documenting the management challenges of centers than examining responses to these challenges. The purpose of this study is to address across a relatively broad base of university research centers (at least when compared to prior research) the structures and management practices used by centers to align the behaviors of department-based faculty with center goals and objectives. Because centers are focused on non-routine, knowledge-based production, one expectation is that centers will be similar structurally to other organizations focused on scientific and technical innovation, including private firms with relatively low levels of complexity, formalization, and centralization. Because centers lack formal personnel authority over their human resources and because goal *incongruence* is in many ways “built in” to centers due to their boundary-spanning characteristics, another general expectation is that the management and leadership practices employed by center leaders will not emulate the practices used by leaders in other organizations focused on scientific and technical innovation, such as private firms

employing systems of “new” human resources management practices aimed at participative decision making, continuous learning, and team-based work (Souitaris 1999, Laursen 2002, Laursen & Foss 2003, Cano & Cano 2006). Instead, centers should employ strategies for developing or at least simulating some of the structures and personnel authorities that can help them to account for different types of goal incongruence.

In the next section (Section 2), the study design and methodology are discussed. Because so little is known about the organizational structures and personnel management strategies of university research centers, the design is multi-case and qualitative – based predominantly on in-depth, semi-structured interviews with the directors and co-directors of 21 university research centers across 2 government centers programs at the NSF, but relying additionally on program and center documentation including requests for proposals, strategic plans, annual reports, and formative evaluations (when available). Section 3 outlines the theory and expectations for the analysis. Section 4 discusses the preliminary findings, which generally demonstrate the anticipated patterns between the general organizational characteristics of centers (e.g., size, technology), boundary-spanning center characteristics, and center directors’ perceptions of goal incongruence. The findings also show perceptions of different types of goal incongruence to correspond with different structuration strategies.¹ The final section (Section 5) discusses the implications for research and theory and for policy and management.

¹ It should be noted that while this introductory section has used the structures and management practices of private companies as a basis of comparison for center structures and practices, empirically this study examines centers only. There is enough consistency across extant research and theory of firms focused on scientific and technical innovation to note differences as they emerge in centers, which have implications not just for centers policy and management but more generally for organization theory as applied to boundary-spanning arrangements.

2. Study design and method

A number of choices regarding the design and method of this study require explanation. The first choice to explain is the selection of university research center cases from but 2 of multiple centers programs from 1 Federal agency, among a population of Federal and State agencies sponsoring university research centers. The second choice to explain is the selection of center cases from these specific centers programs. And the third choice to justify is the use of qualitative rather than quantitative methods. The section concludes with a brief note on the meaning and use of case study findings as empirical evidence informing policy and management decision making.

2.1. Centers program selection

The centers programs used for this study are both at the NSF. The Engineering Research Centers (ERC) and Industry/University Cooperative Research Centers (IUCRC) programs are two of the best known centers programs at NSF (or anywhere), and were selected due to both their similarities and their differences. On one hand, centers sponsored by both programs are university-based, required to have industry partnerships, and must meet similar reporting and other requirements for the NSF. On the other hand, their research missions and resource levels are quite different. Established in the mid 1980s, the ERC program is focused predominantly on creating the knowledge bases for new fields of inquiry and new industries (e.g., tissue engineering) and funds each center on a scale of millions of dollars per year. The IUCRC program is often recognized as the “first” government centers programs in the US, dating to the early 1970s, is focused on providing consulting and transfer support for established industries (e.g., automobile manufacturing), and is funded on a scale that is significantly smaller than ERCs

(Bozeman & Boardman 2004). Thus, while the ERC and IUCRC programs, as NSF university-industry centers programs, are faced with similar constraints and opportunities for structuration and management practice, their respective centers stand to demonstrate structural and managerial differences based on the extent to which they diverge relatively radically or incrementally from existing knowledge and practice (Ettlie et al. 1984) in their research and development activities. This distinction is similar to Tauber's (1974) characterization of the research portfolios of firms as either market dominated (and therefore less risky or incremental) or innovative (and divergent from existing knowledge and practice and therefore more risky).

To be clear, this study is not a comparison of centers programs. It is a cross-case comparison of a set of discrete university research centers. While some differences across center structures and management practices are expected to fall along programmatic lines, the current analysis is focused as much if not more on identifying and explaining *intra*-program differences in center structures and management practices. Discussed below as criteria for selecting a “theoretically representative” (Strauss & Corbin 1997) sample of university research centers, the current analysis additionally emphasizes common antecedents to structure and management practice in organizations, including center size, age, and boundary-spanning characteristics (e.g., disciplinary, institutional, sectoral, geographical). The conceptualization and operationalization of these variables are discussed in the theoretical framework section below; those variables that were used to ensure the representativeness of the cases selected from the ERC and IUCRC programs are discussed immediately below.

2.2. Center case selection

This study is a cross-case comparison of 21 university research centers – 12 IUCRCs and 9 ERCs. Because the programs sponsor dramatically different numbers of centers, different case selection strategies were used for each program. Centers selected from both programs are representative of their respective program’s ranges, in terms of center size, center age, and center multidisciplinaryity. Thus, case selection for the current study may be characterized as “theoretical sampling” (Strauss & Corbin 1997) in that the primary concern was representativeness along key variables (rather random selection). Organizational size (in terms of personnel counts) and age (which may also be considered another proxy for size in terms of the cumulative years a center has received programmatic funding) are known determinants of organizational structure and management practice (Hall & Tolbert 2005). The multidisciplinaryity of a center’s faculty may be interpreted as a proxy for the riskiness or degree of divergence from existing practice of a center’s research mission, which also is a known determinant of structure and personnel management practices (Tauber 1974, Ettlie et al. 1984, Damanpour 1996).

2.2.1. Selecting the IUCRC cases

The IUCRC program currently funds over 70 active university research centers. Because there are too many to include for qualitative case study (the reasons for employing a qualitative methodology is discussed in section 2.3 below), the IUCRC cases were selected based on their representativeness across center size, age, and multidisciplinaryity. Center size was operationalized as the quantity of academic and other researchers considered by center management to be “core” center faculty. This information was drawn mostly from IUCRC Web sites and, when the information was not available online or was online but was not easily interpreted, email queries were sent

to the center's primary contact (usually the center director but sometimes an executive assistant). Center size was determined for every active IUCRC, and cases were selected to represent the full range of IUCRCs in terms of size.

Center age is operationalized as the number of years since the IUCRC received its initial grant from the program. While this measure is not as common in organizational studies as an antecedent to organizational structure and management practice, it is used as an additional case selection variable since collaborations, research and otherwise, tend to become more structured over time (Giddens 1979). Moreover, center age may be interpreted as an additional operationalization of center size – in terms of funding instead of personnel – insofar that older IUCRCs have necessarily received more programmatic funding than younger centers (though they receive the same amount per annum). Center age was determined for every IUCRC and cases were selected to represent the full range of IUCRCs in terms of age.

Center multidisciplinaryity was determined by counting the number of academic departments from which each IUCRC draws its respective faculty. The NSF discipline classification scheme was used to categorize the academic departments, since some universities have different approaches towards horizontal differentiation across disciplines. Accordingly, the multidisciplinaryity of the IUCRC may not be a direct count of the number of different departments from which it draws faculty, but rather may be a lower number insofar that some of the departments fall under the same NSF discipline category. Multidisciplinaryity is conceptualized in the current study as a proxy for the degree to which a center's research mission is "radical" or divergent from existing knowledge and practice, since fields of inquiry that diverge from existing knowledge and

practice as these exist in discipline-based academic departments would probably require input and expertise from multiple disciplines. It is also conceptualized as an important antecedent to goal incongruence among center faculty, which is the key mechanism in the analytic framework for the current analysis. Center multidisciplinaryity was determined for every active IUCRC and cases were selected to represent the full range of IUCRCs in terms of multidisciplinaryity.

Initially, 20 IUCRCs representing the programmatic range for center size, age, and multidisciplinaryity were contacted about participation in the study.² Of these, 12 agreed to participate in the study. Though a substantial proportion (40%) of the selected IUCRCs did not agree participate, the centers that participated are representative of the ranges for center size, age, and multidisciplinaryity for the IUCRC program. In terms of age, the programmatic range is 1-26 and the programmatic inter-quartile range is 3-10. For the selected IUCRCs, the range for size is 2-26 and the inter-quartile range is 4-8. For size, the programmatic range is 2-68 and the programmatic inter-quartile range is 9-27. For the selected IUCRCs, the range of size is 8-68 and the inter-quartile range is 20-30. In terms of center multidisciplinaryity, there was not much variation. For all centers currently active the IUCRC program, the number of disciplines represented by center faculty ranges from 1-5. For those centers used in this study, the range is 1-4.

2.2.2. Selecting the ERC cases

The ERC program currently funds 12 active university research centers. Because this number is much smaller than for the IUCRC program, each center was targeted as a case study. Thus, center size, age, and multidisciplinaryity were not explicit considerations

² Center directors were solicited via email for an initial, semi structured interview to be followed by shorter, structured interviews and analysis of center documentation. See section 2.2. for a full description of the study methodology.

in ERC case selection. The response rate for the ERC solicitations was much higher than for the IUCRC solicitations – of the 12 active ERCs, 9 agreed to participate in the study. The ERCs that did not agree to participate do not differ from those that did choose to participate. Thus, the ERCs that participated are representative of the ranges for center size, age, and multidisciplinaryity for the ERC program. The range in age for ERCs participating in the study was 1-9, the range in size was 25-100, and the range in multidisciplinaryity was 3-9.

Because this study is not intended as a comparison of two NSF centers programs, but more broadly as a 21 case comparison study, the case selections from the IUCRC and ERC programs were not matched (e.g., on field of inquiry, industry sector). Neither program constitutes the counterfactual for the other, nor are the programs similar enough in mission and scale so as to represent alternate mechanisms for achieving the same outcomes. The current analysis is aimed at identifying relationships that explain *intra*-program differences as much as *inter*-program differences across centers' structural and managerial strategies for aligning individual behaviors with center goals and objectives.

2.3. Methodology

This study employs a multi-case methodology drawing on in-depth, semi-structured interviews with center directors and co-directors and analysis of internal and external documentation for each case, including annual reports, Web sites, and, when available, formative evaluations. Thus, the current analysis meets criteria for “good case study” as laid out by Arneson (1993) and also by Yin (1994).³

2.3.1. Conducting the interviews

³ For example, Arneson (1993) suggests that “good case study” must in data collection rely on at least 2 of the following 3 methods: interviews, documentation analysis, and direct observation. Because the current study assesses multiple cases, the third criterion was not feasible.

Center directors and co-directors were solicited for in-depth, semi-structured interviews via email, based on the above-reviewed center variables (i.e., size, age, multidisciplinary). Each interview lasted 1-1.5 hours. Each interview was conducted via telephone. The interviews were recorded and transcribed using a professional online service. Summaries of the transcripts were sent to the respondents and they were invited to correct any inaccuracies. In no cases did respondents identify inaccuracies or request revisions. The interview protocol may be found in Appendix A. No software application was used to organize, code, and analyze the data, given the small number of interviews and also given that the current analysis is not aimed at developing grounded theory (in which case an application like NVivo becomes more useful). The analysis was guided by the theoretical framework articulated in the next section (Section 3) below.

2.3.2. Data coding and analysis

The interviews were coded initially by the interviewer, and there are plans for two additional researchers (one additional faculty member and a graduate research assistant) to blindly code the interviews. While qualitative data are not as conducive to tests for inter-coder reliability as are quantitative measures, most of the variables will be comprised of just 2-3 values or codes. In instances both of agreement and disagreement amongst the coders, decision rules for assigning each case a value for a particular variable will be discussed explicitly. Currently, interviews are ongoing and the data have been coded only by the author.

Thus far the author has conducted two phases of coding. The first phase was relatively “open” (Lee 1999), guided by extant organizational and management theories (discussed in the theory section below) but not limited to the traditional parameters

insofar that university research centers constitute fairly “extreme” cases of boundary-spanning organizations – spanning multiple boundaries including epistemic ones (Corley et al. 2006) and exercising little to no traditional personnel authority (Bozeman & Boardman 2003, Boardman & Bozeman 2007). The second phase of coding was “axial” in that core variables and variable codes were developed to further parse the interview data. The axial variables and variable codes used were proposed by the author, following the original method as proposed by Glaser and Strauss (1967), rather than following the axial categories prescribed by Strauss and Corbin (1997).

*2.4. A comment on empirical evidence and case study*⁴

Policy evaluators and other social scientists approach qualitative research with considerable wariness. Perhaps the single most important reason is the widespread suspicion that case study methods are insufficiently general and theoretical, and that case studies are good for explaining the unique, but not up to the task of providing generalizable explanations (Dyer & Wilkins 1991). However, the chief problems case studies present with respect to theory building flows from one of the method’s strengths. Case studies provide rich detail, nuance, and depth. But, as Eisenhardt (1989, p. 547) notes, one of the more severe problems, that “a hallmark of good theory is parsimony, but given the typically staggering volume of rich data, there is a temptation to build theory which tries to capture everything.” There are two fundamental approaches to deal with the “staggering volume of rich data” problem. Those doing case studies in a “grounded theory” mode eschew hypotheses and use the case or cases to provide a more holistic understanding or, in some cases, to develop broad hypotheses. Another approach, the one used here and elsewhere (Bozeman & Kingsley 1997, Bozeman & Klein 1999), is to

⁴ This sub-section is an excerpt from Boardman & Bozeman (2006).

develop cases based on a model or tentative theory and to determine the extent to which the cases align with the terms of the model. For more general treatment of the strengths and limitations of case study for developing and contributing to theory, see Yin (1981a, 1981b, 1994).

3. Analytic framework and expectations

This study uses a contingency framework to guide comparisons across university research center structures and management practices. The approach draws from the general transaction costs explanation of organizational structure as articulated by Ouchi (1980) and applied more recently in studies comparing the “clan” structures of firms focused on scientific and technical innovation as a core activity to firms with “bureaucratic” structures due to their relatively routine core activities and foci (e.g., Souitaris 1999, Laursen 2002), though the approach is adapted here to facilitate “within group” comparison across university research centers. Accordingly, unlike other studies explaining structuration (or the lack thereof) in organizations, this study does not employ a reference group of organizations that are not focused on knowledge creation and/or technology development. Nor does the current study compare centers to other modes of research collaboration in universities, as do prior assessments of structuration in university research (e.g., Landry & Amara 1998). Rather, the framework is used to address contingencies that account for different management and leadership approaches, formal and informal, towards structuring (broadly defined) university research centers.

3.1. Goal incongruence in university research centers

The analytic framework emphasizes center-level antecedents to and structural outcomes of center directors’ perceptions of goal incongruence among center faculty and

between center faculty and center leadership. Generally, organizations focused on scientific and technical innovation must compensate for relatively low levels of organizational structure, due to the non-routine nature of research and development, with relatively high levels of shared or common goals among individual organization members. Else, individual members will pursue their own objectives rather than coordinate to accomplish organizational goals (Ouchi 1980, Laursen 2002, Laursen & Foss 2003, Cano & Cano 2006). Due to the focus here on university research centers, the framework does not emphasize performance ambiguity – the “other” transaction cost used to explain structuration or the lack thereof – insofar that there is little reason to expect variation across centers regarding the extent to which the inputs and outputs of the knowledge creation and technology development processes may be measured and routinized.⁵

There is good reason to emphasize goal incongruence when assessing organizational structures and management practices across university research centers. First, centers span multiple boundaries. They typically coordinate researchers from across academic disciplines, universities, sectors, and also across geographic boundaries – which exacerbates the problem of formulating clear goals (Tushman 1979). Even characterizing centers as pursuing the relatively clear (though general) goals of knowledge creation and technology development, there remains good reason to expect goal incongruence amongst center faculty. For example, scientists and engineers from different disciplinary backgrounds approach problems in different ways, have different

⁵ Research and development as work tasks are knowledge-based, involve numerous exceptions, and thus may be characterized as relatively non-routine, perhaps even more so for center-based research and development drawing on multiple disciplines for knowledge contributions. Accordingly, there is no reason to expect variation across centers in this regard. Hence, it is unlikely that university research centers will demonstrate levels of vertical differentiation resembling bureaucracies.

standards and criteria for knowledge creation, and are accustomed to different modes of knowledge dissemination (REF).

Second, even if goal incongruence is alleviated amongst center faculty, perhaps due to common interest in solving a specific scientific or technical problem, goal incongruence between center leadership and center faculty may well still exist. Study of university faculty working with ERCs, one of the government centers programs from which case centers were drawn for the current analysis, show center faculty with primary appointments in academic departments to experience “role strain” and, subsequently, to shirk center work due to divergence between center and departmental expectations for research and dissemination (Boardman and Bozeman 2007).

Thus, the current study conceptualizes two sources of goal incongruence – that stemming from multidisciplinary faculty working together and that occurring between center faculty and center leadership. These variables are discussed in the next section (Section 3.2.) as antecedents to center directors’ perceptions of goal incongruence.

Before discussing these and the other variables in the framework, the operationalization of goal incongruence in this study requires explanation. Typically, assessments of structure or the lack thereof in organizations focused on scientific and technical innovation address goal incongruence indirectly. For example, studies of firms focused on science and technology interpret the delegation of decision making rights horizontally and vertically as facilitating congruence between management and workers (e.g., Laursen 2002). Pay for performance is another practice emphasized in studies of innovation firms, if not as facilitating goal congruence then at the least as helping to align individual behaviors with organizational goals. In their assessment of structure in

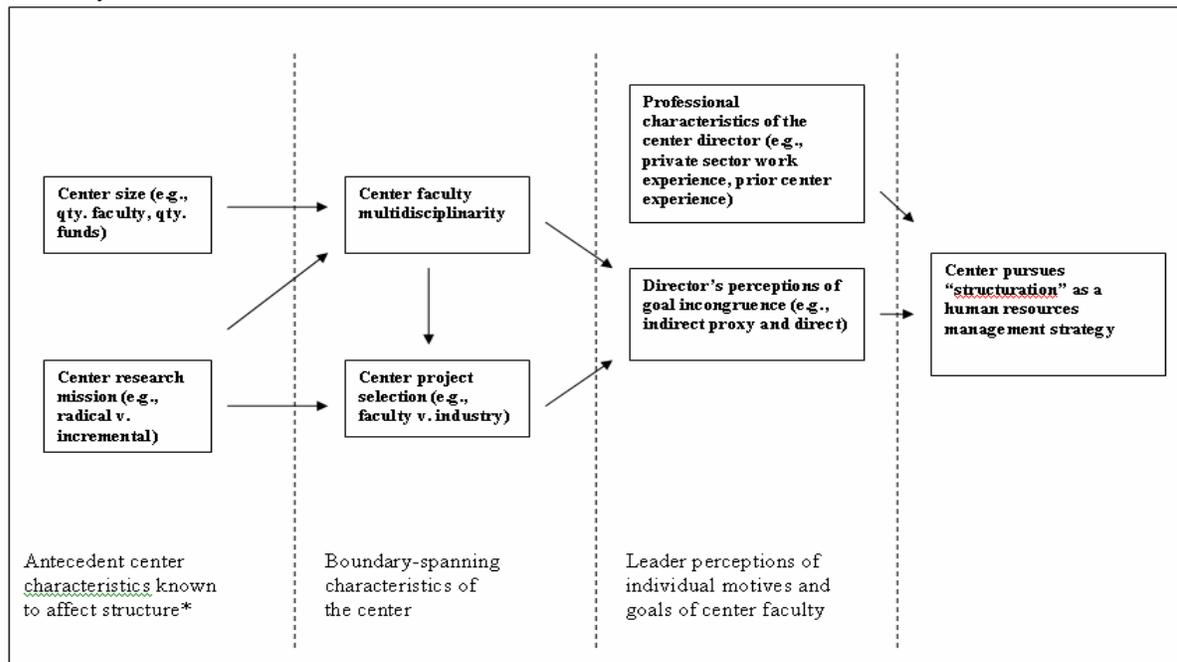
university-based research collaborations, Landry and Amara (1998) assess cost increasing dimensions of intra-collaboration transactions as proxies for goal incongruence, such as human asset specificity. The authors also rely on direct reports of cost perceptions (e.g., for project coordination) among collaborating researchers.

While many of these factors are included in the current analysis in one form or another, the analytic framework (see Figure 1 below) emphasizes perceptions of goal incongruence (versus perceptions of costs) by center leadership. There are a number of reasons for this added emphasis. First, university research centers usually are not established by any sort of systematic process for organizational design emphasizing prospective evaluations of coordination and other transaction costs (Boardman and Corley 2008). Instead, center structures and management practices are essentially choices made by center directors, based on their informal observations about the motivations and goals of center faculty and other stakeholders (e.g., industry partners) and perhaps also based on their past career experiences (e.g., in industry, in other centers). Accordingly, in addition to proxies for high coordination costs found in previous study, the current analysis emphasizes center directors' perceptions of faculty motivations and goals for center participation. Even if these perceptions prove inaccurate, they no less inform decisions about center structure and management.

Last, it should be noted that seldom do studies aimed at predicting and explaining organizational structure and management practice rely on direct measures of goal incongruence. Neither the current study nor the literature discussed thus far compare

reports of individual goals amongst organizational members.⁶ However, for organizations that are relatively small (in terms of personnel and funding) and as “leader driven” as are university research centers and other organizations focused on scientific and technical innovation (Ettlie et al. 1984, Davis & Bryant, forthcoming), the consideration of leader perceptions of goal incongruence in addition to the typical constraints and opportunities for structuration (see the framework below) cover the key inputs into decision making about how to organize individuals collectively towards particular goals.

Figure 1. Analytic framework for assessing organizational structures and management practices in university research centers



*Some antecedents known to affect structure (i.e., organizational environment) are excluded from the framework due to a lack of variation across the comparison cases included in the analysis. This is discussed further below.

The analytic framework includes both direct and indirect perceptions of goal incongruence by center leadership. The direct approach to “perceived goal incongruence” asks center directors to discuss the extent to which, if at all, they consider the goals of

⁶ However, there are studies that assess directly goal incongruence (and also “value congruence”) in organizations, though these studies typically are not intended to address structuration and management practice. See XXX,XXX, XXX for examples.

individual faculty as divergent from or convergent with the goals of the center, for instance in terms of knowledge creation and dissemination (see the interview protocol in Appendix A). The indirect operationalization is based on an interview protocol item asking center directors to discuss what they perceive as the primary motivation for faculty to participate in the center. In instances when the center director has a relatively resource-based view of faculty motivation (e.g., for access to research funds), perceived goal incongruence is interpreted as higher than when the director has a capacity-based or “scientific and technical human capital” (Bozeman et al. 2001) view of faculty motivation (e.g., for access to collaborators that enhance individual research capacities). Of course, these are not mutually-exclusive categories. Responses that allude to both types of motives are interpreted as less perceived goal incongruence relative to responses that allude to resource-based motives only. Again, one of the assumptions of the framework is that perceptions matter for decision-making about structure and management practice in university research centers, in addition to relatively standard variables representing potential transaction costs of organizing university faculty towards center goals.

3.2. Antecedents

The framework includes antecedent variables emphasized in general assessments of organizational structure and management practice as well as more specific variables emphasized in analyses of structure and management in organizations focused on scientific and technical innovation (and on non-routine, knowledge-based work more generally). Some of the operationalizations have been modified due to the unique characteristics of university research centers.

3.2.1. General organizational characteristics as antecedent

Generally, organizational environment, technology, and size are considered important as determinants of organizational structure and management practice (Hall & Tolbert 2005). The framework in Figure 1 addresses variation in technology by drawing case centers from university research centers programs with distinct research and development missions. Discussed above, the ERC program at the NSF has a research and development mission that is relatively progressive, aimed at establishing the knowledge bases for nascent industries and more generally for new fields of inquiry (e.g., tissue engineering), whereas the IUCRC program funds university research centers to assist established industries (e.g., auto manufacturing) with more specific (and sometimes firm-specific) projects that represent the application of existing knowledge and technology to solve production and other sorts of process problems in companies (Bozeman & Boardman 2004). This distinction was supported by an IUCRC director participating in the current study who formerly directed an ERC (more than a decade earlier), observing that while there is “tremendous emphasis on industry support” in IUCRCs, that ERCs are “more focused on creating new fields.”

The distinction between the research and development missions of the ERC and IUCRC programs falls in line with distinctions made among firms focused on scientific and technical innovation. Tauber (1974) observes that while some technology companies focus their research programs on innovations that are relatively close to market, other firms engage in higher risk research and development that may not realize commercial returns. Duchesneau and colleagues (1979), Hage (1980), and Damanpour (1996) similarly observe that research and development in firms may diverge or converge with

extant knowledge and practice. Ettlie and colleagues (1984) and Dewar and Dutton (1986) distinguish “radical” from “incremental” innovation. These and other studies generally find a positive relationship between the conduct of research and development that is relatively risky or radical in its divergence from existing knowledge and practice and organizational structuration, though at the same time it is important to remember that organizations focused on scientific and technical innovation generally are less structured than organizations focused on core activities more amenable to routinization (Ouchi 1980, Laursen 2002, Soutaris 1999).

The framework addresses the organizational size of university research centers in two ways. First, the size of each case center is measured by the number of “core” faculty affiliated with the center. These counts typically are limited to department-based academic faculty who are lead investigators for one or more center projects, though for some centers the counts additionally include research faculty who are not on the tenure track in a department, but rather work directly for the center as full time employees. Also, some tenure track faculty may be affiliated with centers, but do not play a critical role in center research and development, for instance, they may participate on review and advisory panels for the center. These individuals are not included in center size counts.⁷ Generally, size as measured by personnel counts correlates positively with structuration in organizations, as managers attempt to coordinate and control diversified activities (Child 1973, Mintzberg 1979, Hall & Tolbert 2005).

Though not specified in the framework, the analysis additionally controls for the number of years each center case has received programmatic funds. This may be

⁷ See Section 2 (on study design and method) for discussion of the difference between “core” and other affiliated faculty in centers, including the method and decision rules for determining the personnel count operationalization of center size.

considered as an alternative operationalization of center size insofar that the older the center, the more cumulative program funds it has received, which is consistent with alternate measures of size emphasizing funds and net assets (Scott 1992). A more appropriate conceptualization may simply be center “age.” Organization age can increase structure in firms, though age has not held up as a consistent or important determinant of structure (Mintzberg 1979). Yet, center age may prove important given the unique life cycles and contexts of university research centers. As some of the interview findings presented below suggest, learning over time on the part of center directors affects how centers are structured and managed, though the operational mechanism emphasized in these reports is the perception of goal incongruence (and efforts to alleviate the incongruence) rather than center age per se. Given this pattern, the age measure proves useful for ensuring theoretical representativeness among the university research centers included in the cross-case comparison (see Section 2.2).

The last variable typically considered an important determinant of organizational structure – organizational environment (and the uncertainty thereof) – is excluded from the framework because university research centers sponsored by the ERC and IUCRC programs are exposed to comparable constraints and opportunities for structuration and management practice. Both types of center are university-based and reliant predominantly on university faculty with primary appointments in academic departments; both are required by the NSF to develop industry partnerships; and both must meet similar reporting and other requirements for the NSF. More broadly, as successful recipients of NSF and probably other agency funds, both ERCs and IUCRCs are exposed

to the same constricted environment for Federally-funded research and development (Ziman 1994).

3.2.2. Boundary-spanning characteristics of centers as antecedent

The above discussion of general antecedents to structuration suggests that there can be different levels of structure in organizations focused on scientific and technical innovation, based on (among other factors) the extent to which an organization's research and development diverges from existing knowledge and practice (Ettlie et al. 1984, Dewar & Dutton 1986). Because solving complex problems usually requires the integration of different disciplinary knowledge and skills (Gibbons et al. 1994), it is reasonable to expect university research centers engaged in relatively "radical" research and development to draw on multiple rather than fewer disciplines to assemble diverse sets of university faculty with the collective capacity to conduct problem-focused (versus discipline-focused) research. As organizations comprised of a multidisciplinary faculty, such centers necessarily diverge from "existing knowledge and practice" as it exists in traditional academic departments drawing on a less diverse faculty to further a specific discipline. Accordingly, as relatively "radical" research agendas demonstrate to correlate positively with structuration in firms focused on innovation as a core activity, center multidisciplinary may correlate positively with center structuration.

For the current study, center multidisciplinary is more useful conceptualized as an antecedent to goal incongruence amongst center faculty. Researchers with different disciplinary backgrounds and training may approach the same problem in different ways, have different standards and criteria for knowledge creation, and be accustomed to different modes of knowledge dissemination (REF). Thus, the individual goals of a

particular center's multidisciplinary faculty may be viewed by the center director as divergent or incongruent and requiring a greater degree of complexity and formalization for communication and coordination among center faculty towards accomplishing the multidisciplinary work of the center. Whether or not in reality multidisciplinary research collaboration is actually characterized by higher degrees of goal incongruence probably does not matter. Center directors are themselves scientists or engineers with primary appointments in academic departments and with training in a specific field or discipline, so they will likely perceive the management task of coordinating faculty with divergent disciplinary backgrounds and training as requiring structure.

The framework in Figure 1 includes a measure for center multidisciplinary, which is operationalized as the number of NSF discipline codes represented by the departmental affiliations of a center's core faculty. The NSF discipline classification scheme was used to categorize the academic departments, since some universities have different approaches towards horizontal differentiation across disciplines. Accordingly, the multidisciplinary of a center may not be a direct count of the number of different departments from which it draws faculty, but rather may be a lower number insofar that some of the departments fall under the same NSF discipline category. Individual researchers' departmental affiliations were used rather than the respective disciplines in which they received their doctorates, due to the relative difficulty in obtaining career trajectory information.

Another boundary spanned by many university research centers is the university-industry boundary. While all of the centers included in the current analysis are required by the NSF to have industry partners, the nature of centers' industry ties can vary in ways

that may affect the extent to which center directors perceive goal incongruence between center faculty and center leadership (which is different than the goal incongruence just discussed, amongst multidisciplinary center faculty). For instance, centers' industry partnerships may entail the conduct of specific projects for specific companies, or they may entail open access to center research and researchers by all industry partners (Lal et al. 2007). Similar, private companies may partner with centers to gain access to upstream modes of knowledge or they may do so for technical assistance in resolving process or production problems (Santoro & Chakrabarti 2002). Accordingly, project selection and funding decisions in centers may be driven predominantly by industry partners (e.g., in cases of specific projects for specific companies) or they may be driven predominantly by center faculty (e.g., in cases when companies partnering with a center have general access to the same research and researchers). It seems likely that center directors will perceive goal incongruence between faculty and center goals when center project selection and funding decisions are driven by industry partners rather than by faculty, in which cases directors will be more likely to perceive the management task of aligning center faculty behaviors with center goals as requiring some sort of structural or managerial solution.

The framework includes a variable for center decision making regarding project selection and funding. While other assessments of structuration in university-based research collaborations address additional types of decisions (e.g., administrative, research design and methodology), the decision most conducive to incongruence between center faculty and leadership are probably those directly related to the allocation of resources. Other decisions that may be conducive to goal incongruence amongst center faculty, rather than between center faculty and center leadership, such as decisions about

research design and methodology (see Landry & Amara 1998), are probably captured by the center multidisciplinary measure discussed above.

Last, other boundaries that are typically spanned by university research centers – such as geographic and university boundaries – are excluded from the analytic framework because they do not seem conducive to perceptions of goal incongruence by center directors. For example, biologists working at separate universities in separate regions of the US, but on the same problem and conjointly for the same university research center, are perhaps no more likely to have incongruent goals than same-discipline research collaborations occurring in a same biology department at a same university. Moreover, these biologists' goals will be comparably incongruent with the goals of center leadership only in the instance that the center employs an industry-driven project selection and funding process, which also has nothing to do with the geographic and university boundaries that separate these researchers.

3.3. Structuration and management outcomes of perceived goal incongruence

Discussion of structuration and management in university research centers has thus far been diffuse. Because so little is known about the structures and management practices of centers, this study was designed to be relatively exploratory on the matter. Though much of the above-reviewed research and theory for structuration and management practices in firms focused on scientific and technical innovation prove useful for anticipating general and boundary-spanning antecedents to perceived goal incongruence in centers, there is good reason to expect quite different structural and managerial responses to goal incongruence in centers when compared to private companies.

First, university research centers typically lack formal personnel authority over center faculty and thus are not responsible for faculty salaries, promotion, and other conventional inducements (Boardman & Bozeman 2003). Indeed, both of the NSF centers programs from which cases were drawn for the current analysis require core center faculty to be tenured or on the tenure track in academic departments. Thus, pay-for-performance, while useful as part of systems of “new” human resources management practices for facilitating scientific and technical productivity in firms (Cano & Cano 2006), is generally not an option in centers. Second, many other “new” human resources management practices used by firms focused on scientific and technical innovation seem attempts to emulate to the organizational cultures of centers, such as job rotation, continuous learning, and workforce training and development (see Souitaris 1999, Laursen 2002, Laursen & Foss 2003, Cano & Cano 2006).

As university-based research collaborations, centers generally already possess many of these features to facilitate knowledge-based work in teams. Yet, in many instances centers face relatively high levels of goal incongruence due to the multidisciplinary nature and industry-focus of center research and development (Boardman & Bozeman 2007). Accordingly, it seems that centers will try to account for this by way of some sort of socialization process and/or by some attempt at structuration (Ouchi 1980), albeit within the constraints of a university-based research collaboration with no formal personnel authority and no conventional inducements. This stands in contrast to firms focused on scientific and technical innovation, which generally seem to pursue a strategy of structural “flattening” in order to align individual goals, or at least

individual behaviors, towards scientific and technical innovation and production (see Souitaris 1999, Laursen 2002, Laursen & Foss 2003, Cano & Cano 2006).

What structuration and management strategies university research centers pursue for alleviating the problem of goal incongruence (when it exists) is an open question. Attempts at structuring center activities may include borrowing structure and personnel authority by tying into other organizations that possess more direct control over center faculty, such as developing formal or informal relations with the academic departments from which they draw faculty. Another strategy may be to create new personnel authority and structure by hiring research faculty without academic appointments to perform aspects of center research and development that are incongruent with the goals of core faculty. Yet another approach may be to develop some semblance of structure for governing core faculty, for instance by establishing complexity and formalization for faculty interactions and behaviors on center projects. At the least, when center directors perceive goal incongruence, they will work informally to attain buy-in from academic faculty.

3.4. Expected relationships between antecedents, perceived goal congruence, and center structure

The above discussion of the analytic framework suggests specific expectations regarding the relationships between general organizational characteristics of centers, boundary-spanning characteristics, perceived goal incongruence by center directors, and center structuration and management practices. Table 1 summarizes these expectations.

Table 1. Predictions regarding the characteristics of university research centers

Center characteristics	Expectations		
	Variation across centers	Expected direction of effect on perceived goal incongruence	Expected direction of effect on center “structuration”
Center R&D mission diverges from existing knowledge and practice	Yes	Positive	Positive
Center size	Yes	Positive	Positive
Center multidisciplinary	Yes	Positive	Positive
Industry members driving center R&D decisions	Yes	Positive	Positive
Center director has industry experience and/or prior center experience	Yes	Positive	Positive
Center environment*	No	Not applicable	Not applicable
Performance ambiguity*	No	Not applicable	Not applicable -

*Center characteristics for which the current focus on ERCs and IUCRCs is not likely to observe variability are excluded from the analysis

The overarching expectation for this study is that centers will demonstrate structuration when center directors perceive goal incongruence among center faculty or between center faculty and center leadership. Because centers, as organizations, are relatively small and oftentimes dependent on the vision of a founder or leader (Davis & Bryant, forthcoming), center directors exercise a great deal of discretion over center structure and management practice. Hence, contrary to some characterizations (e.g., Landry & Amara 1998), centers may demonstrate no structural differences when compared to informal research collaborations without the sponsorship of a government centers program, or they may demonstrate a relatively “high” level of structuration for university-based research – depending on the extent to which center directors perceive goal incongruence and depending on the importance of any incongruence they perceive.

The upshot of the focus on perceived goal incongruence by center directors is that center structuration and management may be idiosyncratic, as individual perceptions may

be. There may be instances in which a university research center has all of the ingredients for goal incongruence – a multidisciplinary faculty, an industry-driven project selection and funding process – yet demonstrates no structural or managerial responses due to the director perceiving no incongruence. Or, a center may exhibit relative advanced structural characteristics for governing faculty behavior, such as matrix management, owing more to the fact that the director used to be a project manager in industry than to the presence of any of the above-discussed antecedents to goal incongruence. Such personal idiosyncrasies are also included in the analytic framework in Figure 1 above.

4. Preliminary findings⁸

Based on preliminary coding of the 21 interviews with center directors (and supported by information drawn from annual reports and strategic plans, when documents were available), the specific and general expectations for the analytic framework are supported by the case findings. Specifically, most of the relationships included in Table 1 above are supported, except in some cases when individual idiosyncrasies of the center director (e.g., past work experience a project manager in an engineering firm) affected decisions and strategies for center organization and management. The general expectation that perceptions of goal incongruence by center directors would occur with structuration, broadly defined, in centers is supported, and there are clear patterns between direct versus indirect perceptions of goal incongruence and the structuration strategies taken by center directors in response.

4.1. Patterns between the antecedents and perceived goal incongruence

⁸ This study is ongoing. The data from the interviews have undergone only preliminary “open” coding by the author. Secondary or “axial” coding by the author as well as by two additional researchers will be conducted to ensure reliability.

The preliminary analysis of the case findings shows a number of the expected patterns between general organizational characteristics for centers (i.e. size, technology), boundary-spanning center characteristics (i.e., multidisciplinary faculty, industry-driven project selection and funding process), and perceived goal incongruence (using the direct measure, see Section 3.1. above) by center directors. Some of these patterns fall along predominantly programmatic lines, while the majority does not. Also, there were some deviations from the expectations expressed in Table 1 above.

There were some notable differences in the ways goal incongruence was perceived by the participants. For example, most of the ERC directors perceived goal incongruence amongst faculty working on interdisciplinary projects, but not in terms of incongruence between faculty goals and center goals. In contrast, most of the IUCRC directors perceived goal incongruence between faculty and center goals, but not amongst center faculty. This pattern seems partly a function of program research mission, insofar that the ERC program has a more progressive or “radical” research and development mission than does the IUCRC program (Bozeman & Boardman 2004) and, subsequently, ERCs tend to draw on more disciplines and departments for faculty than IUCRCs (see Section 2.). Moreover, most of the ERCs included in the study employ a faculty-driven project selection and funding process, while most of the IUCRCs use an industry-driven process.

However, exceptions to these programmatic patterns suggest the boundary-spanning characteristics to be the chief operational mechanisms affecting perceptions of goal incongruence in center directors. For instance, some of the IUCRCs that are as multidisciplinary as many ERCs employ faculty-driven project selection and funding

projects, whose directors conceptualized goal incongruence amongst faculty rather than between faculty goals and center goals. Similar, ERCs drawing on fewer disciplines were more likely to employ an industry-driven project selection and funding process, whose directors perceived goal incongruence amongst center faculty rather than between faculty and leadership.⁹

Table 2. Preliminary findings: general patterns for perceived goal incongruence

Center characteristics	Type of goal incongruence perceived		Type of faculty motivation perceived	
	Amongst center faculty	Between faculty and center	Capacity-based	Resource-based
Center R&D mission diverges from existing knowledge and practice	No discernible pattern	No discernible pattern	Positive	No discernible pattern
Center size	No discernible pattern	No discernible pattern	No discernible pattern	No discernible pattern
Center multidisciplinary	Positive	No discernible pattern	Positive	No discernible pattern
Industry members driving center R&D decisions	No discernible pattern	Positive	No discernible pattern	Positive

*Center characteristics for which the current focus on ERCs and IUCRCs is not likely to observe variability are excluded from the analysis.

Thus, there seem at work in university research centers two sources of goal incongruence – multidisciplinary across center faculty and industry influence over resource allocation – and two types of goal incongruence perceived by center directors – that between faculty members with different backgrounds and training and that between center faculty and center leadership, respectively. Notably, the directors of the few centers (1 ERC and 2 IUCRCs) that have both sources of goal incongruence perceived both types of goal incongruence.

⁹ These exceptions occurred for the most multidisciplinary IUCRCs included in the study (4 disciplines) and the least multidisciplinary ERC (3 disciplines).

The interview findings also reveal some patterns between the direct indicator for perceived goal incongruence (which has been the focus of the findings thus far) and the indirect indicator asking about directors' perceptions of faculty motives for working with the center (see Section 3.2.). Directors perceiving goal incongruence amongst a multidisciplinary center faculty generally reported that it is the opportunity to work with such a diverse faculty that draws faculty to the center. Hence multidisciplinary seems at the same time a management advantage (in terms of faculty recruitment) and a management challenge (in terms of goal incongruence). Directors perceiving goal incongruence between center faculty and center goals generally reported that the chief motivation for faculty to work in the center was access to research funding, both through the center and through the potential for individual investigator industry contracts with partner companies. These motives become more important with regard to the findings for center structuration.

4.2. Patterns between perceived goal incongruence and center "structuration" strategies

Center directors discussed numerous approaches towards structuring and managing center projects and faculty, including establishing formal and informal relations with the academic departments from which they draw faculty, hiring research faculty (without academic appointments) over whom they can exercise more direct management and personnel authority, relying on research faculty and also on post-doctoral researchers to fulfill center research and development not conducive to publications and/or patents, as well as implementing relatively complex and formal

structures to govern project staffing and timelines, such as matrix management.¹⁰ Some patterns between perceived goal incongruence by center directors and different structuration strategies emerged from the preliminary qualitative analysis. Exceptions to these patterns occurred when center directors had prior career experience in private companies and when they had prior experience in other university research centers.

The most notable pattern is that center directors who did not perceive goal incongruence of either type (discussed above, see Section 4.1.), or who perceived it but thought it unimportant, did not report center structuration strategies (or even management practices) of any sort. These respondents generally communicated a *laissez-faire* approach to center management and, beyond determining the allocation of center resources, reported imparting few if any structures or requirements on center faculty. Moreover, these centers rely exclusively on tenured- and tenure-track faculty and reported no formal connections with the academic departments from which they draw their human resources. Some (but not all) of these centers exhibited the sources of goal incongruence discussed above, namely relatively high levels of multidisciplinary and/or industry-driven project selection and funding processes. Thus, the extent to which goal incongruence is perceived by center directors, or is perceived as important by center directors, seems to matter as much to center structuration as the typical antecedents emphasized in organization studies.

The other general pattern from the preliminary analysis is that when center directors perceive goal incongruence and consider it problematic for achieving center goals, they engage in structuration strategies of one form or another. It should be noted

¹⁰ The coding for this component of the case findings is incomplete. There are likely more general types of structuration strategies employed by center directors than are discussed here. Moreover, each type that is discussed may have variations to be detected by further qualitative data coding and analysis.

that the term structuration is being used here in a broader sense than in typical organization studies, to include not just the implementation of formalization and complexity as well as incentives like summer pay, but additionally the utilization of other academic departments' structures and personnel authorities, the acquisition of personnel over whom it may be easier to impose structure when compared to department-based faculty, as well as less formal socialization efforts to generate faculty buy-in.

Table 3. Preliminary findings: general patterns for center structuration strategies

Type of goal incongruence perceived		Type of structuration strategy pursued				
Amongst center faculty	Between faculty and center	Research faculty and/or post-docs	Ties to academic departments	Formalization and complexity	Socialization	Other
No	No	No	No	No	No	??
Yes	No	No	No	Yes	Yes	??
No	Yes	Yes*	Yes*	No	Yes	??
Yes	Yes	Yes*	Yes*	Yes	Yes	??

*Denotes within-structuration strategy type variation that is discussed below;
 ?? denotes that data analysis is still underway

Table 3 summarized the specific patterns. Generally, center directors perceiving goal incongruence amongst center faculty but not between faculty goals and center goals reported relying on relatively traditional modes of structure, including prospective documentation of the contributions expected of center faculty by center leadership for specific projects, as well as scientific advisory boards to oversee the allocation of funds and to evaluate projects for progress towards center goals. This type of structuration was not evident in case centers whose directors did not perceive intra-faculty goal incongruence.

Another discernible pattern based on the preliminary analysis is related to perceptions of incongruence between faculty and center goals. These center directors expressed, more often than others, establishing ties, formal and informal, with the

academic departments from which they draw faculty. These directors explained this strategy in terms of keeping departments aware of the diverse responsibilities and duties of their center faculty. This practice was more common in case centers drawing on fewer, and in some cases just one, academic department for faculty. Center directors perceiving incongruence between faculty goals and center goals also were more likely to employ research faculty and/or post-doctoral researchers – doctoral level researchers who are not on the tenure track in an academic department.¹¹ Directors reported hiring this sort of researcher to conduct the bench-level activities that are not conducive to the outputs valued by department-based faculty. As perceptions of different types of goal incongruence do not map closely to whether the case center is an IUCRC or an ERC, neither do these patterns in center structuration strategy map closely to program affiliation.

The last observation is that center directors observing goal incongruence amongst multidisciplinary faculty and between faculty goals and center goals generally employ more comprehensive structuration strategies than directors who perceive just one type of goal incongruence. However, the difference in this pattern is not just cumulative, there are some differences, for example, in the types of ties these centers report having to academic departments. Centers characterized by both types of goal incongruence typically had less formal connections with academic departments, perhaps because these centers tended to be more multidisciplinary. These centers also seem to rely more on post-doctoral researchers than on research faculty when compared to center directors

¹¹ The difference between research faculty and post-docs may be an important one. Research faculty are here considered full time employees, while post-docs are soft-money employees. During the interviews, the author was certain to make sure the respondents understood this distinction before discussing either type of worker.

reporting goal incongruence between the faculty and center but not amongst a multidisciplinary faculty.

Exceptions to the general patterns discussed in this section occurred for one of two reasons. Discussed above, while some center directors perceived goal incongruence of one or the other type, they did not view it their role to intervene in the activities of center faculty, and hence pursued no structuration strategy beyond informal attempts at socialization and generating buy-in. The other exception occurred when center directors perceive no goal incongruence yet pursue a structuration strategy. In one instance, the director had project management experience and used matrix management to organize center faculty. In another, the director of a single-discipline center hired research faculty due to “bad experiences” more than a decade earlier as the director of a multidisciplinary center.

Again, these findings are preliminary. Interview transcription and coding and document analysis are still underway. Hence there may prove additional structuration strategies than are discussed here, and the patterns between the strategies and perceived goal incongruence may change as well.

5. Brief discussion

These preliminary findings suggest a number of implications for research and theory and for centers policy and management.

5.1. Implications for research and theory

For research, the findings suggest that university research centers differ in the extent to which they structure the research collaborations they are intended to facilitate, contrary to prior investigations treating centers as more or less structurally monolithic

(e.g. Landry & Amara 1998). Within-group comparisons across university research centers reveal as much structural heterogeneity as demonstrate broader comparisons of centers to other types of research collaboration. Center directors seem to select structuration strategies that address the particular type(s) of goal incongruence they perceive as challenges to accomplishing center goals. While some centers included in the analysis were as informal and unstructured as traditional discipline-based research collaborations, others showed to be multifaceted in their structuration strategies.

Thus, prior explanations characterizing the structuration of research collaborations as “university research centers or not” as a choice *made by collaborators* seems misguided (e.g., Landry & Amara 1998). First, centers grants, at least in the US, are awarded on a competitive basis. Assuming that researchers apply for centers grants because the grants can help to further their respective research agendas, it seems that the “center or not” choice is one that is made by government centers programs, not by the researchers. Some faculty win centers grants and pursue their research agendas, others do not win centers grants and pursue their research agendas. How to structure research collaborations in pursuit of a particular research agenda is a choice that all faculty make, based perhaps more on the challenges and barriers they perceive, rather than on the fact that a proportion of their research funding happens to come from a particular source.

For theory, centers’ strategies for scientific and technical innovation seem the inverse of those demonstrated by private companies focused on science and technology. Whereas innovation firms have implemented “new” human resources management practices to facilitate continuous learning, team-based work, and other characteristics already demonstrated by centers and other university-based research collaborations,

centers seem to employ strategies for simulating some of the structures and authorities characteristic of firms. Thus, the traditional distinction made by researchers of strategic human resources management between personnel authority and participative management as “technical” and “strategic,” respectively (Huselid et al. 1997), may be the reverse for boundary-spanning organizations characterized by high levels of goal incongruence. Center strategies for aligning and achieving goals include obtaining personnel authority where typically they have none and generating structure rather than removing it.

5.1. Implications for policy and management

The current study provides more insight for management than for policy. For management, the results demonstrate patterns between structuration strategies in centers and different types of goal incongruence that are useful considerations for centers directors, centers program administrators, and extramural evaluators. The results help to discern centers’ activities and processes that may help to explain why a center performs well or does not. For policy, whether the structuration strategies employed by center directors matter is an open question until further study is conducted assessing the impact of structuration on center performance.

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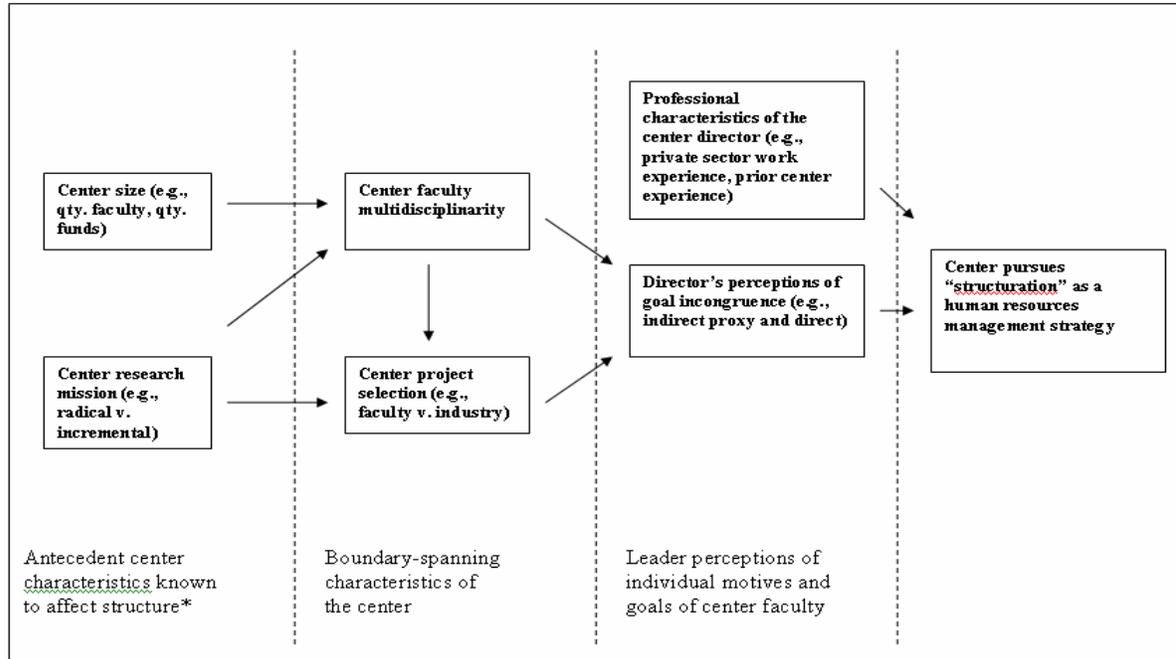
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Figures and tables

Figure 1. Analytic framework for assessing organizational structures and management practices in university research centers



*Some antecedents known to affect structure (i.e., organizational environment) are excluded from the framework due to a lack of variation across the comparison cases included in the analysis. This is discussed further below.

Table 1. Predictions regarding the characteristics of university research centers

Center characteristics	Expectations		
	Variation across centers	Expected direction of effect on perceived goal incongruence	Expected direction of effect on center "structuration"
Center R&D mission diverges from existing knowledge and practice	Yes	Positive	Positive
Center size	Yes	Positive	Positive
Center multidisciplinary	Yes	Positive	Positive
Industry members driving center R&D decisions	Yes	Positive	Positive
Center director has industry experience and/or prior center experience	Yes	Positive	Positive
Center environment*	No	Not applicable	Not applicable
Performance ambiguity*	No	Not applicable	Not applicable -

*Center characteristics for which the current focus on ERCs and IUCRCs is not likely to observe variability are excluded from the analysis.

Table 2. Preliminary findings: general patterns for perceived goal incongruence

Center characteristics	Type of goal incongruence perceived		Type of faculty motivation perceived	
	Amongst center faculty	Between faculty and center	Capacity-based	Resource-based
Center R&D mission diverges from existing knowledge and practice	No discernible pattern	No discernible pattern	Positive	No discernible pattern
Center size	No discernible pattern	No discernible pattern	No discernible pattern	No discernible pattern
Center multidisciplinary	Positive	No discernible pattern	Positive	No discernible pattern
Industry members driving center R&D decisions	No discernible pattern	Positive	No discernible pattern	Positive

Table 3. Preliminary findings: general patterns for center structuration strategies

Type of goal incongruence perceived		Type of structuration strategy pursued				
Amongst center faculty	Between faculty and center	Research faculty and/or post-docs	Ties to academic departments	Formalization and complexity	Socialization	Other
No	No	No	No	No	No	??
Yes	No	No	No	Yes	Yes	??
No	Yes	Yes	Yes	No	Yes	??
Yes	Yes	Yes	Yes	Yes	Yes	??

Appendix: interview protocol

SECTION 1. CENTER HUMAN RESOURCES INVENTORY.

Note: The purpose of this section is to understand the composition of the center's "workforce" that may constitute differences in personnel management practices and strategy across centers. Some of this information may be available online, but sometimes this type of information is not evident from the center Web site or from annual reports. Accordingly, some of these questions may have to be asked at the outset of the interview.

1. How many academic researchers (i.e., with primary appointments in academic departments) do you count as center faculty?
 - a. Level (i.e., junior, tenured)?
 - b. From how many different departments?
 - c. What proportion of the faculty is at the home institution?
 - d. What is the nature of the center appointments (e.g., formal, informal)?
 - e. How many PIs does the center have? How many are co-located?
2. How is it determined that a faculty member is counted as part of the center? E.g., What determines center affiliation?
 - a. Formal or informal?
 - b. Dedicated time (e.g., 51% rule)?
 - c. Something else?
3. Does your center employ full-time or part-time researchers who are not appointed to a department as tenured or on the tenure-track?
 - a. Level (i.e., doctoral, masters)?
 - b. How many?
4. Does your center support post-doctoral researchers?
 - a. How many?
 - b. What is the typical tenure for a post-doc?
 - c. When did your center start supporting post-docs?
 - i. Since, has your center's approach to/use of post-docs changed (if at all)?
5. Does your center support student researchers?
 - a. Level (i.e., undergrad, masters, doctoral)?
 - b. How many?
6. Under what circumstances do you recruit new faculty or hire additional researchers?
 - a. What is your recruitment strategy?
 - b. Is the strategy aimed at formal arrangements between the center and faculty?
 - c. Or is the strategy less formal? Explain.
7. Does your center employ any professional and/or support staff?
 - a. For what functions (e.g., grants support, industry relations, general administration)?
 - b. How many?

SECTION 2. STRUCTURING CENTER INTERACTIONS.

Note: The purpose of this section is to understand the center's structural features, including horizontal and vertical differentiation (i.e., complexity), formalization (i.e., rules and procedures), and lines of responsibility and authority (i.e., centralization). Some of this information may be available online, but sometimes this type of information is not evident from the center Web site or other documentation. Accordingly, most of these questions will probably have to be included as part of the interview.

1. Is your center divided into research groups?
 - a. What are the "division rules?" Are the groups project based? Or are they based on disciplinary foci?
 - b. Are the "division rules" static or dynamic? Does membership of the groups vary based on the project or is membership more or less set?
 - c. Why is the center organized in this way?
 - d. What would you consider changing?
2. Do center researchers work "on site" in a common space or is the center "virtual" (e.g., with researchers working from their own labs)?
3. Does the center have rules or procedures for data or equipment access, knowledge use, et cetera?
 - a. Related to IPR?
 - b. Other rules?
 - c. Are the rules formal or implicit?
 - d. What is the purpose of these rules? Do they work? Have you considered changing them?
4. Can faculty publish based on the center research?
5. What personnel authority (e.g., hire, raise, fire) do you exercise?
 - a. Over department-based faculty? (If any)
 - b. Over other research personnel (e.g., students, post-docs)?
 - c. Are there formal personnel policies articulated for the center?

SECTION 3. THE CENTER DIRECTOR'S MANAGEMENT STYLE.

Note: The purpose of this section is to understand the center director's management style. Style here is operationalized by a number of leadership theories including contingency theory, leader-member exchange theory, and related theories of worker motivation. This section is perhaps the most important of the interview insofar that most centers will not exercise any "technical" personnel management authority related to compensation, promotion, et cetera.

1. What role do you play in center research?
 - a. Do you participate in projects? Are you leading projects? Or do you limit your participation to research management?
 - b. How would you characterize your research management? Do you feel you exercise strong influence over the direction of research projects? Or are you more "hands off" in providing researchers with autonomy?
2. How frequently do you interact with your department based faculty? With other, non-department researchers?
 - a. Are there regularly scheduled meetings or conference calls?

- b. What is the nature (usually) of the interactions? E.g., what are the issues about which they interact?
- 3. How would you characterize the exchanges you have with your department-based faculty?
 - a. Formal versus informal? Collegiality? Trust?
 - b. How are your exchanges with department-based faculty different than with other researchers in the center?
- 4. How would you describe your leadership or management “style?”
 - a. Focused on developing interpersonal relations and collegiality amongst faculty?
 - b. Focused on achieving scientific and technical goals?
 - c. Focused on career development of center faculty?
 - d. Is decision making in the center participative or do you and your co-PIs make most decisions (e.g., regarding direction of research, allocation of resources, et cetera)?
- 5. How do you define successful performance on the part of your faculty and researchers?
- 6. How do you reward successful performance in the center?
- 7. How do you promote a culture of collaboration across the center’s diverse faculty?
 - a. Structural approaches? (see section 2 above)
 - b. Workshops, meetings, other?
- 8. How has your center leadership strategy evolved over the years?
 - a. If so, how?
 - b. Were there key events that led to the new strategy?

SECTION 4. MANAGING DEPARTMENT-BASED CENTER FACULTY.

Note: The purpose of this section is to understand the nature of the center director’s relationship with department-based faculty. These items draw from theories of “technical” versus “strategic” human resources management practices as well as from theories of role conflict and role strain. There may be overlap in the discussion generated by the above questions on management style.

- 1. What do you think motivates department-based faculty to work in the center?
- 2. What incentives do you offer faculty?
 - a. Research funds?
 - b. Salary buy-out (e.g., reduced teaching load)
 - c. Additional financial remuneration?
 - d. Access to other research-related resources (e.g., data, equipment, infrastructure, collaborators, industry, students)?
- 3. Does the center have formal or informal relations with any academic departments?
 - a. What is the nature of these relations?
 - b. Which departments? Why some departments but not others?
 - c. What was the impetus for these relations?
 - d. What are the benefits? The setbacks?

4. Does the center have any input into departmental tenure and promotion decisions for department-based center faculty?
 - a. What is the nature of this input?
 - b. Which departments? Why some departments but not others?
 - c. What was the impetus for these relations?
 - d. What are the benefits? The setbacks?
5. Does the center provide any guidance or mentoring for the career development of junior-level faculty?
6. Does the center conduct performance reviews of its department-based faculty?
 - a. If yes, what is assessed?
 - b. How is the performance information used to inform decision making for the center?
 - c. Is the review shared with the department or other parties (e.g., the dean)?
 - i. How if at all is the review used to inform decision making in the researchers' departments?
 - d. If the center does not review the performance of its faculty, why not? How does the center keep track of the contributions of its core faculty?
 - e. How if at all do you reward faculty performance in the center?
7. How do you attain buy-in from your department-based faculty?
8. What steps have you taken to distribute the work load and avoid burnout?

SECTION 5. MANAGING FULL TIME RESEARCHERS (NOT DEPARTMENT BASED).

The purpose of this section is to understand the nature of the roles of full time, non-departmental researchers in the center and how they are managed.

1. What roles do these researchers play in the center? What's the division of labor/responsibilities?
 - a. Core versus non-core?
 - b. Routine versus non-routine?
 - c. Degree of autonomy?
2. What's the relative importance of these non-faculty researchers? How important are they to the center's goals and objectives?
3. What are the career paths and opportunities for advancement for these researchers in the center?
4. Does the center offer training and development opportunities (e.g., workshops, conferences)?
5. How long has the center relied on these researchers? What was the impetus for bringing them in?
6. Are these researchers employees of the center or another unit (e.g., college, school, university)? Where does the responsibility lie for typical/technical personnel functions?
7. Who oversees the work performed by these researchers?
 - a. The director?
 - b. Another faculty member?

8. Does the center conduct performance reviews for these researchers?
 - a. If yes, what performance information is assessed?
 - b. Who has input into the process?
 - c. How is the performance information used?
 - d. How is good performance rewarded in the center?

SECTION 6. MANAGING POST-DOCTORAL RESEARCHERS.

The purpose of this section is to understand the nature of the roles of post-doctoral researchers in the center and how they are managed.

1. What roles do these researchers play in the center? What's the division of labor/responsibilities?
 - a. Core versus non-core?
 - b. Routine versus non-routine?
 - c. Degree of autonomy?
2. What's the relative importance of post-docs? How important are they to the center's goals and objectives?
3. What are the career paths and opportunities for advancement for these researchers in the center?
4. Does the center offer training and development opportunities (e.g., workshops, conferences)?
5. How long has the center relied on these researchers? What was the impetus for bringing them in?
6. Are these researchers employees of the center or another unit (e.g., college, school, university)? Where does the responsibility lie for typical/technical personnel functions?
7. Who oversees the work performed by these researchers?
 - a. The director?
 - b. Another faculty member?
8. Does the center conduct performance reviews for these researchers?
 - e. If yes, what performance information is assessed?
 - f. Who has input into the process?
 - g. How is the performance information used?
 - h. How is good performance rewarded in the center?

SECTION 7. MANAGING GRADUATE STUDENT RESEARCHERS.

The purpose of this section is to understand the nature of the roles of graduate student researchers in the center and how they are managed. Be sure to address the level(s) of graduate students in the center (per section 1).

1. What roles do these researchers play in the center? What's the division of labor/responsibilities?
 - a. Core versus non-core?
 - b. Routine versus non-routine?

- c. Degree of autonomy?
2. What's the relative importance of graduate students? How important are they to the center's goals and objectives?
 3. What are the career paths and opportunities for advancement for these researchers in the center?
 4. Does the center offer training and development opportunities (e.g., workshops, conferences)?
 5. How long has the center relied on these researchers? What was the impetus for bringing them in?
 6. Are these researchers employees of the center or another unit (e.g., college, school, university)? Where does the responsibility lie for typical/technical personnel functions?
 7. Who oversees the work performed by these researchers?
 - a. The director?
 - b. Another faculty member?
 8. Has the center produced any masters or doctoral theses?
 9. Does the center conduct performance reviews for these researchers?
 - a. If yes, what performance information is assessed?
 - b. Who has input into the process?
 - c. How is the performance information used?
 - d. How is good performance rewarded in the center?