

DESIGNING CENTERS:

Principles for Effective Organizational Structure

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C H A P T E R 3

INTRODUCTION

“Just as a keystone supports an arch, so too some organizational mechanism is required to support long-term connections between the business and academic communities.”—(Matthews and Norgaard, 1984, p. 176)

For several decades, American research universities have been confronted with a difficult dilemma: industry has begun to demand research assistance which is long-term, mission-driven, multidisciplinary, and team-based; university values, norms and administrative practices are ill-equipped to handle and often antagonistic towards many of these needs. As we pointed out earlier, most universities have tried to resolve this incompatibility by creating and deploying boundary-spanning structures, specifically centers, which are more consistent with industry’s needs and yet well integrated into the university proper. In principle, this so-called centers strategy allows the university to meet a pressing need in its environment without changing its core structure.

It is important to remember that boundary-spanning units are more than organizational bandaids. They should be conceived as an actual organization with their own structure, management, leadership, and strategy. To succeed, these center features must be tailored to meet the needs of its external stakeholders. In this

chapter we focus our attention on the most visible and stable organizational feature of a center, its structure.

What Is Structure?

Hall (1977) has drawn an analogy between organizations and buildings. For instance, all buildings have relatively static and stable structural features, including beams, interior walls, passageways, roofs, that dictate the movements and activities of people within the building and within specific rooms. In similar fashion, all organizations have structural features that dictate activities and interactions of organizational participants.

In the context of a center, structure asks: Where would this unit report within the university? Who would report to whom? How would center reporting relationships affect traditional reporting relationships? How would various tasks be defined and allocated? How would priorities be set and decisions made? How would activities and interactions within this unit and between this unit and the university, industry and sponsor groups be coordinated? Structure is important because it encompasses many aspects of a center we can deliberately create; it shapes activities and processes and thereby influences the achievement of organizational goals.

While organizational theorists tend to differ somewhat on specific dimensions of structure, for our purposes, we will use Robbins (1990), who summarizes structure into complexity, centrality, and formality.

Complexity

The extent of differentiation within an organization: horizontal, or the division of labor, degree of horizontal separation between units; vertical, the depth of the organizational hierarchy; and spatial differentiation, the geographic location of offices and personnel.

Centralization

The "degree to which the formal authority to make discretionary choices is concentrated in an individual, unit, or level (usually high in the organization)." (Robbins, 1990, p. 106.) Centralization can vary within a given unit or organization based on the kind of decision involved (e.g., some decisions may be centralized, others decentralized). Decision-making is also a multi-step process. Discretion early-on in decision-making contributes to decentralization.

Formality

The degree to which an organization relies on rules and procedures to direct and standardize the behavior of its members. Formality can vary across jobs and functions and is manifested in job descriptions, rules, policies and procedures. Formalization can also be accomplished by *unwritten* and implicit norms and expectations or can be “internalized” within members by virtue of professionalization.

Design Principle for I/UCRC Structure

Designing an organization involves choices. There is no single ideal organization. Thus, most organizational theorists adopt a contingency approach to design issues, arguing that organizational features including structure, strategy, and goals depend on a number of factors.

For instance, complex organizations are better equipped to handle large, diverse and far flung tasks, but may strain a manager’s span of control and require greater coordination and communication. Centralization increases control and in some instances efficiency, but usually has a negative effect on speed of decisions, collaboration, and motivation. Formal structures tend to be more predictable and easy to manage but also tend to be less flexible and innovative.

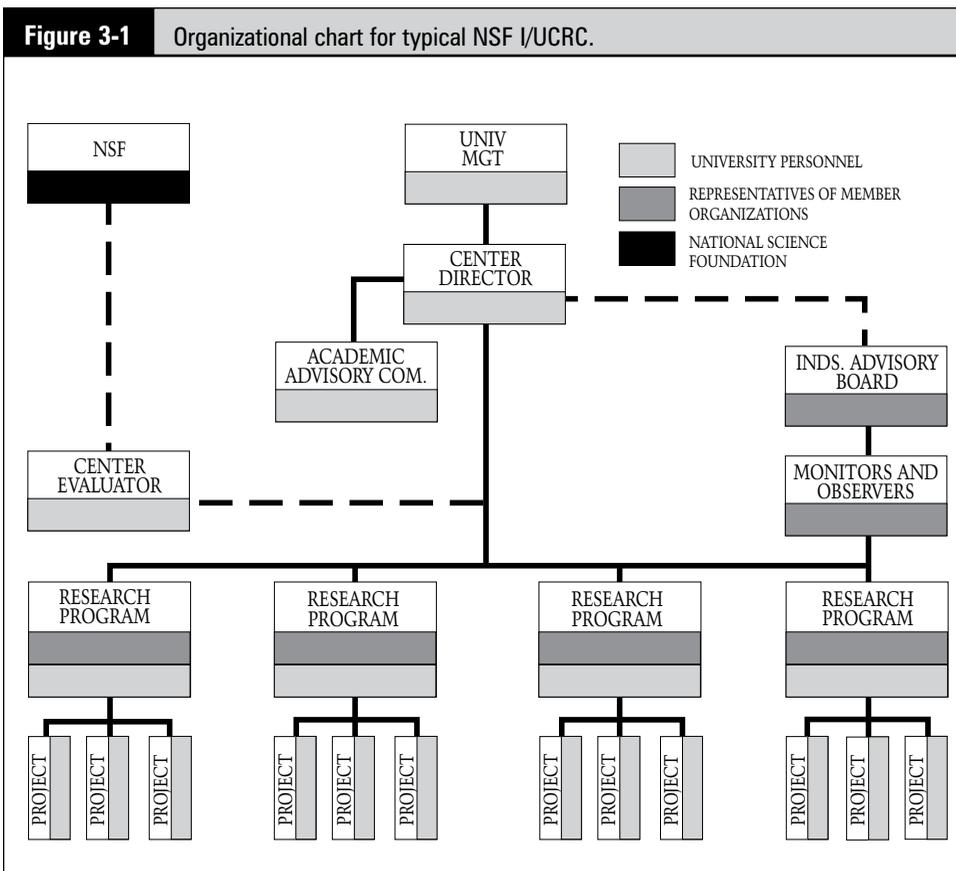
Fortunately, center designers face a relatively common context of small size, demand for innovative scientific work, a complex and fast-changing environment, and a goal of conducting and transferring high-quality industry-relevant research in a highly professional and individualistic culture. This has allowed centers to use similar structures.

Complexity

Because most centers are relatively small, the structure for an I/UCRC is simple. Figure 3-1 shows vertical differentiation is limited to an administrative function, management by the Center Director, and research.

Horizontal differentiation is also limited. Although the center’s research is typically grouped by problem areas, the research function (staffed by a faculty member and graduate students) also exhibits little differentiation.³ Most centers have faculty from a single university, so spatial differentiation has tended to be quite limited.

³Even when these factors are taken into account, most theorists argue principle of “equifinality,” more than one structure achieves the same result.



Probably the most noteworthy element of the organizational chart is the presence of a number of external linkages: an Industrial Advisory Board (IAB) comprised of one representative from each member company, an Academic Advisory Committee (AAC) which represents center academic and administration interests.

Not every center fits these recommendations. In fact, an increasing number of I/UCRCs have grown quite large or have added geographically remote research sites. Structural modifications necessitated by these situations are not great and are described in Chapter 11.

Centralization

Centralization of decision making within a center depends on the kind of decision. According to our research, I/UCRCs follow a

fairly consistent and relatively effective pattern of decision making (Gray & Gidley, 1987). First, many administrative matters can and probably should be routinized and centralized with the Center Director having considerable discretion. Strategic matters including planning of the research program and project selection should be carried out in a participatory manner but with industrial sponsors making the final recommendation. This approach also helps prevent the Center Director from conflict of interest among his/her colleagues. In similar fashion, operational research decisions should involve considerable discussion and participation but ultimately should be made at the lowest level possible (e.g., project level).

Obviously, there are occasions when centers will want to deviate from some or all of these guidelines. Some Center Directors prefer to make administrative decisions with considerable colleague collaboration (see Chapter 10). Under certain circumstances such as loss of an IAB member or faculty, the Center Directors should reorder research priorities.

Formality

Formalization can make a center predictable and reliable; it can also make it rigid, inflexible, and bureaucratic. I/UCRCs have addressed this paradox by varying the amount of formalization by function and job. Formalization is high for I/UCRCs when the university center and the sponsor interact, moderate within the administrative function and low within the research and external linkage functions.

An overview of the organizational design of a typical I/UCRC shows a simple structure centralized on strategic issues but very decentralized on research operations, formal at the top and at its industrial network, but low in formalization of the research function. Most of these features can be observed in the organizational chart for a typical I/UCRC (Figure 3-1). Interestingly, the recommended structure for a center bears a strong resemblance to the organic structure observed in many innovative organizations (Tornatzky and Fleischer, 1990).

While these principles provide a rough outline for designing a center (see Figure 3-2), "the devil is in the details." In the next section we describe specific structural features that help define the I/UCRC model.

Figure 3-2 Design principles for an I/URC.

Structural Dimension/Feature	Structural Implications
<i>Complexity</i>	
Small Size (Employees, Sites)	Low General Complexity
Multiple Stakeholders	Higher Complexity (Linkage Function)
<i>Centralization</i>	
Bureaucratic Host	Centralized (Administrative)
Multiple Customers	Centralized (Strategic)
Knowledge Creation	Decentralized (Research)
Consortial Arrangement	Decentralized (Strategic)
<i>Formality</i>	
Research and Development	Low Formality (Research)
Competitive; Fast Changing	Low Formality (Research)
Bureaucratic Host	High Formality (Administrative)
Intellectual Property	High Formality (Sponsor Interface)
Level of Professionalism	Low Formality (Research)
Government-sponsorship	High Formality (Administrative)

CENTER FUNCTIONS, ROLES AND RESPONSIBILITIES

University Administration

An I/UCRC must report somewhere within the university's hierarchy. Over 85 percent of I/UCRCs operating during 1996, reported to a dean's level or higher. And for good reason. Centers are by definition multidisciplinary, boundary-spanning units which may create turf problems among academic units or require dispensation from standard university operating procedure. As a consequence, it is important for a center to report as high within the university hierarchy as possible (dean's level when faculty come from different departments or provost when faculty span across colleges). Reporting at a high level has a number of benefits. Specifically, it increases the chances that a center and its faculty won't get caught up in parochial department turf battles; the responsible university official will have authority, and, it is hoped, the inclination to

give the center a certain degree of autonomy; the center will be in line with other units when discretionary resources are being handed out.

It's worth noting that while a center may find itself above departmental politics, most researchers don't. As faculty members, most directors and center researchers are members of academic departments. They report to department heads, are reviewed by senior faculty for promotion and tenure and must publish in journals recognized by their discipline. While serious problems appear to be rare, directors who control more resources than their department head, and young untenured faculty who are expected to publish in disciplinary journals, are well advised to be sensitive to conflicts.

Responsible University Official

The center reports to an official within the university hierarchy who has authority over policies and procedures, decisions about the research programs, and allocation of resources. While the role played by this administrator varies from university to university, few become involved in the direct management of the center or second-guess the research priorities of the IAB. In fact, most limit themselves to monitoring, oversight, including ensuring that the center maintains high standards with respect to education and research, ensuring that the center follows established university procedures, and coordinates with departments and other centers. These responsibilities usually are accomplished by reviewing center reports and planning documents, reviewing and responding to the feedback and recommendations from the IAB, and conducting periodic reviews.

Some administrators go beyond this relatively benign role and become strong advocates for centers and see them as *opportunities* for significantly increasing extramural research and enhancing the university's reputation. Such individuals may dispense with various rules by waiving or reducing overhead rates or using non-traditional criteria such as intellectual property to evaluate center faculty. They assist in recruiting industry members, and try to enhance a center's capabilities when they allocate faculty positions to departments. Research indicates that the presence of such an individual contributes to a center's success (Gray, Stewart, et al., 1991).

Academic Advisory Committee (AAC)

If it ain't broke, don't fix it. If you don't have a problem, don't convene your AAC. — Anonymous Center Director

The Academic Advisory Committee serves as a linkage mechanism for advice and feedback about operations, policy, and research issues between the university's academic core and the Center Director and the responsible university official. It typically includes academic department heads or deans involved in the center and relevant university administrators. AACs are essential when formulating center policies and procedures, when major policy changes occur and when a major problem occurs. As a center matures and policies and procedures become routinized, the AAC's role diminishes. Many successful I/UCRCs have never convened the AAC once they were established.

Center Administration

Depending upon their size, centers can function successfully with only a Center Director and an administrative assistant. However, the scope and complexity of their required tasks are enormous.

Center Director

The key role to center success. S/he is responsible for the management and administration of internal operations, the research program and recruitment of industrial sponsors. A sample job description is provided in Figure 3-3. We recommend that the directorship be a full-time position. Unfortunately, because of budgetary constraints, this has become a luxury only a few NSF funded I/UCRCs can afford. While centers have functioned with part-time directors, the center may lose its technical direction or membership base. Shouldering what is a full-time Center Director's job on a part-time basis can result in burnout and a perception among one's colleagues that you are not sharing equally in departmental duties (Gray, et al., 1991). This probably contributes to the high turnover rate among Directors within the NSF I/UCRC Program.

If budgetary restrictions rule out a full-time director, one is left with two options: either hire a professional-level administrative assistant, or share or delegate some of the responsibilities with other faculty. The latter option is discussed in Chapter 10.

Administrative Assistant

Most centers have an administrative assistant who reports to the Center Director. How this position is defined and filled has tremendous impact on the Center Director's workload and the

Figure 3-3 Sample job description—Center Director.

- Reports to the responsible university representative.
- Responds to recommendations from the Industrial Advisory Board.
- Responsible for the management and administration of internal operations of the center including:
 - Budget control,
 - Maintenance of the center databases, records, and publications,
 - Organization of the semi-annual meetings,
 - Preparation of the center annual report, completion of surveys and reports required by a NSF and university administrations.
- Responsible for the management and administration of research operations of the center including:
 - Preparation and implementation of the center's long-range plan and research plan,
 - Monitoring and oversight of research projects.
- Responsible for the management and administration of external operations of the center including:
 - Coordination of industry recruiting efforts,
 - Facilitation of technology transfer to member firms,
 - Preparation of public relations materials.
- Responsible for communication and coordination among all center operations.

center's success. Administrative assistant responsibilities vary from basic secretarial and clerical duties to primary responsibility for budgets and much of the center's internal management and operations. In some centers, administrative assistants have even assumed some recruitment responsibility and become associate directors. Obviously, duties depend upon the qualifications of the incumbent, grade-level, and salary of the position. Some centers may find it necessary to "create" or improvise a brand new university job description in order to hire a professional level administrative assistant.

Evaluator

NSF I/UCRC program administration requires all centers to include an evaluator who collects information by observation and surveys of IAB members and faculty. Evaluators provide objective feedback on center processes and outcomes to assist in refining

operations and to anticipate problems. Because of the experience they have acquired over the years, some evaluators are used by their directors as management and organizational development consultants. The evaluator typically is a faculty member from another department on campus and is supported by NSF. The role and responsibilities of the evaluator are described in Chapter 8.

Research

The research project is the fundamental work unit of any center. However, in order for a center to succeed, it must offer industry more than tangentially related research projects often found within academic departments or university institutes and laboratories. Centers must offer sponsors a coherent collection of industry-relevant, multidisciplinary research projects which exhibit cross-fertilization and demonstrate synergy. In order to accomplish this goal, I/UCRC's core research (which is selected by a consensus of all members and supported by membership fees) is typically organized within program areas and by research project. When properly managed, a center research project should operate like a virtual-team, comprised of university and industrial contributors.

Program Areas

Program areas are research projects which have been grouped around a coherent theme, led by an area coordinator. As Figure 3-4 shows, a program area may be organized around either purely scientific or industrial themes. It is critical that program areas reflect the interests and capabilities of available faculty and have relevance to the center's industrial members. Further, since most centers do not have the resources to cover all of the topics which might interest their sponsors, it is important that its research areas be complementary and provide an opportunity for synergy. Program areas usually emerge over time.

Center program area teams are *ad hoc* and loose rather than the highly structured teams observed in industrial research organizations. This flexible approach produces cross-fertilization across related projects and seems better suited to a university-based consortia for a number of reasons: it allows greater flexibility in addressing emerging needs or opportunities, it allows greater flexibility in capitalizing on the interests and talents of current and new faculty, and is consistent with an organizational culture where faculty can be encouraged but not ordered to work on a given project or topic.

Figure 3-4 Typical I/UCRC research areas.

<p>Center for Non-destructive Evaluation</p> <ul style="list-style-type: none"> ■ Ultrasonics ■ Electromagnetic measurement ■ Image enhancement techniques ■ Microfocus radiography 	<p>Berkeley Sensor and Actuator Center</p> <ul style="list-style-type: none"> ■ Scientific fundamentals ■ Fabrications techniques ■ Microdevices for sensing and actuation ■ Integrated microsystems
<p>Center for Grinding Research and Development</p> <ul style="list-style-type: none"> ■ Grinding machine and grinding process dynamics ■ Truing and dressing of grinding wheels ■ Thermal aspects of the grinding process ■ Grinding fluid studies 	<p>Center for Advanced Computing and Communications</p> <ul style="list-style-type: none"> ■ High speed networking ■ Reliable fault-tolerant systems ■ Digital communications ■ Distributed systems ■ Image analysis

Area Coordinators

Typically, one faculty member is designated coordinator for a center program area. While responsibilities vary, the role of a coordinator is that of a facilitator. The responsibilities of the area coordinator might include fostering communication and collaboration among projects, stimulating and facilitating development of new projects within the area, representing the area's research (current and proposed) to outside groups including the IAB and prospective industrial members. In some larger centers, an area coordinator might be responsible for some duties typically assumed by the director including monitoring project progress.

Research Projects and Virtual Teams

A typical project is carried out by a small team of researchers including one or several principal investigators (PIs) and researchers. Most PIs are tenure-track faculty or post-doctoral research associates. Most of the research is carried out by talented graduate students and frequently constitutes the student's thesis or dissertation.

Although center projects tend to be staffed like university research-as-usual, the highly interactive process used to develop, refine, and manage projects is designed to lead to a very different

product. First, project ideas are developed based on intensive interactions between investigators and industry and other university researchers, not by an isolated faculty member. These virtual teams are invariably multidisciplinary in composition. Further, funded projects have all passed the scrutiny and addressed the concerns of a team of industrial sponsors. In addition, projects are subject to at least semi-annual, if not ongoing, review by the same group of individuals, with refinements made as necessary. (See Chapter 5 for a more detailed description of the steps and transactions involved in project planning and management.)

Center projects sometimes involve actual bench-level collaboration with industrial colleagues. Such arrangements can work well and can be very profitable for both sides. Unfortunately, bench-level collaboration is rare because of a reluctance by industry to encourage their researchers to take visiting scientists positions, lack of resources at centers to subsidize these arrangements, day-to-day pressures within industry which undermine part-time collaborations, and concerns about how to handle proprietary interests in shared projects. In spite of this, the rewards of such arrangements are great.

Principal Investigators and Researchers

Most university PIs make technical decisions consistent with the research plan, supervise or carry out the research, operate within an established budget, and prepare reports. Centers ask more of their PIs. The PI is also the key member of the virtual research team, which includes industrial partners. As a consequence, center PIs communicate and cooperate with industrial sponsor representatives during every stage, from proposal development to post project completion to feasibility testing. As members of the center's research team, PIs also have responsibility for communicating and coordinating with other investigators within their program area and within the center. Finally, because most centers operate with a very lean administrative function, PIs also become actively involved in administrative duties like retention and recruitment efforts.

EXTERNAL LINKAGE FUNCTIONS

Centers exist in order to conduct industry-relevant research within the university and to facilitate transfer of the fruits of this work to industry. However, accomplishing both these objectives

within the context of a center is complicated by the fact centers involve a relationship with a consortium of firms rather than a single firm and often involve sponsorship by one or several government agencies. Not surprisingly, balancing the needs and interests of individual stakeholders can be a challenging task. As a consequence, the external linkage function of a center is probably the most critical and challenging element of its organizational structure. Within I/UCRCs, these challenges are met through the Industrial Advisory Board and through the roles of industrial member, industrial monitor and government member.

Industrial Advisory Board

The IAB is a board of directors with one voting representative from each sponsor organization⁴. The IAB meets twice-a-year and makes recommendations on policy and research. IAB decisions are not binding on the university. However, because industry provides the vast majority of the center's financial support and because the areas in which industry can express its voice are clearly spelled out in the center's bylaws, IAB recommendations are usually upheld.

Although industry wields considerable influence over a center's research program, this has not meant applied, narrow, and short-term projects. Research on two different NSF-sponsored cooperative research models has shown that industry consortia give significantly higher priority to fundamental research and significantly lower priority to patents and product development than firms involved in one-on-one arrangements with the university (Gray, et al., 1986). Firms are reluctant to disclose specific short-term problems to their competitors. In doing so, they may divulge proprietary or embarrassing information. Even if this were not the case, industrial sponsors avoid sharing resources to solve a problem specific to one of their competitors.

Industrial Advisory Board Members

IAB members represent the interests of their organization within the center. The typical IAB member is a manager in R&D, engineering, manufacturing, or similar function. They are responsible for reviewing and evaluating proposed and ongoing research proj-

⁴Some centers have affiliated members at a lower membership fee. Affiliate members may or may not have voting rights.

ects, and acting as a gatekeeper for information and technology developed within the center. They are also responsible for casting the sponsor's vote on matters which affect policy or the center's research program. Since IAB members must periodically evaluate the value of center membership, it is desirable to have a board member who is an advocate for center membership.

The IAB selects a chairperson who runs the executive session of the IAB meeting and represents the IAB interests between semi-annual meetings. Chairs are elected from volunteers or are selected on some rotation scheme. Volunteers usually do the best job. Chairpersons can become very active in recruiting new members or in stimulating interest in projects.

Industrial Monitor

Even the most motivated and technically talented IAB member has difficulty keeping up with all of the research projects covered by a typical center. As a consequence, most centers allow members to designate and send as many industrial monitors (usually bench-level scientists) to meetings as they like. Some centers have found it useful to designate one or several monitors as project mentors. These individuals take a more active role in project guidance and knowledge and technology transfer. Since monitors are likely successors to your current IAB member, their interest and involvement should be a top priority.

NSF/Government

While government agencies who join a center usually have all the rights as industrial members, NSF serves as an ex-officio (non-voting) member of the IAB. Within the I/UCRC program, the NSF representative plays a much more active role. The responsibilities of the NSF representative include promotion and dissemination of the I/UCRC model, technical assistance on management and operations, and advocacy for the center to the university and industry.

FORMALIZATION: GOVERNANCE, POLICIES AND PROCEDURES

The final element of structure is formalization. As we noted, formalization can make a center predictable and reliable; it can also make it rigid, inflexible, and bureaucratic. I/UCRCs have addressed this paradox by varying the amount of formalization

by function and job. Specifically, formalization for I/UCRCs typically is high at the university-center interface, high at the sponsor-center interface for some matters (e.g., intellectual property), moderate within the administrative function and low within the research and research linkage functions.

University and Center Interface

Most universities tend to be highly formal, but the degree and type of formality differs across institutions. For instance, state and land grant institutions tend to have a more formal structure than private institutions, and will have detailed rules on issues like extension activities other universities rarely address. Each center must develop an approach to formality which is consistent with that of the host institution.

Most centers have little or no discretion over university policies and procedures that cover personnel appointments, budget, ownership of equipment and facilities, intellectual property, etc. The same is true for individual scientists who participate in a center. Center scientists are also university faculty and must comply with applicable rules governing their appointments.

This does not mean that center researchers inevitably must comply with every university rule and procedure. In order to serve as true boundary-spanning units, faculty and students working in centers must be unfettered by some of the more onerous constraints imposed by the university. In some instances, centers have actually been a vehicle for changing university rules or policies. For instance, many universities have changed or clarified their rules on publication delays in order to accommodate the needs of centers and their sponsors. In other instances, most I/UCRCs have been given significant cost sharing.

Centers can improve their bargaining position in two ways. Centers are more likely to negotiate change in university rules when they report high within the university hierarchy. Since departments and colleges impose their own formalities, the higher a center reports within the university, the more discretion it has. Second, use NSF or other government agency guidelines as a lever within the university. A variety of institutional changes have occurred because NSF required or expects certain policies to be in place.

“Don’t ask for permission, if the person you’re asking only has the power to say ‘no’.”

IAB and Center Interface

As boundary-spanning organizations, centers require commitments from outside stakeholder groups. Since these commitments involve legally binding transactions such as exchange of money, completion of research projects, hiring of personnel and commitment of resources to projects and the creation and protection of intellectual property, many of these issues must be covered in a very formal, legally binding manner. Government-University-Industry Roundtable (1993) has published guidelines for developing such agreements. Reams (1986) has examined a number of university and industry contractual agreements and has identified 65 issues which can be covered in such a contract (see Appendix 3-1 for a complete list). Fortunately, most I/UCRCs and their sponsors have found it necessary to address only a subset of all of these issues. They get at the heart of center governance and are usually addressed in the Membership Agreement and the Bylaws.

Membership Agreement

The membership agreement is a formal legal contract between the university and industrial sponsor and is signed by officers representing each. Developing this document can be time-consuming because a center must develop a single agreement upon which all parties can agree. While a membership agreement can and should be tailored to the needs of the industrial member involved in a particular center, most membership agreements are similar. Elements covered in a standard I/UCRC Membership Agreement are shown in Figure 3-5; Appendix 3-2 contains a sample membership agreement and Appendix 3-3 shows how one center has used the reverse side of the agreement to re-state benefits of membership. Additional aspects of these agreements are discussed below.

Membership Requirements

Although antitrust concerns related to center membership have all but disappeared since the passage of the National Cooperative Research Act in 1985, centers must avoid limiting or restricting membership arbitrarily. Centers can, however, limit membership to firms incorporated in the U.S. which have significant R&D or manufacturing operations located within the U.S. Centers may want to register as a Cooperative Research Venture with the Department of Commerce. This will provide members additional protection from antitrust concerns.

Figure 3-5 Elements of typical center membership agreement.

<p>Parties: Specifies legal entities signing the agreement.</p> <p>Purpose: Simple statement of the purpose of constituting the center.</p> <p>Participants: Identification of other parties, like the National Science Foundation, involved in the center.</p> <p>Membership Requirements: Criteria organizations must meet to be considered for membership.</p> <p>Membership Fees: Description of the cost of membership, manner of payment and schedule of payment (full or associate membership).</p> <p>Length and Terms of Commitment: Number of years agreement will be in force and conditions for terminating agreement.</p>	<p>Organization and Operation: Usually references bylaws for these details.</p> <p>IAB Role. General statement of the role, responsibilities and rights of IAB members (with additional details covered in bylaws).</p> <p>Publication Policy: Description of the procedures for reviewing publications and the circumstances and length of permissible publication delays.</p> <p>Intellectual Property Policy: Description of the ownership and rights to all intellectual property discovered through center research.</p> <p>Indemnification: Each party holds the other harmless.</p> <p>Official Signature: Signatures of designated representatives.</p>
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Membership fees. Membership in an I/UCRC involves paying a fixed annual membership fee. The average membership fee within the NSF I/UCRC Program is currently \$35,000 per year. Approximately 25 percent of I/UCRCs encourage membership by smaller firms by offering an associate membership at an average \$18,000 per year. Associate members have limited rights (e.g., voting privileges; access to research areas or reports and intellectual property).

New centers should set their fees carefully. In spite of inflation, it's difficult to raise membership fees once a contract has been signed. At least one center has overcome this problem by having periodic fee increases reflected in the membership agreement. (See Chapter 11.)

Length and term of commitment. The typical I/UCRC agreement is for three years with a cancellation provision of 90-day notice. This arrangement appears to work. It allows firms which are operating under budgetary uncertainty to make a moral commitment to a center for several years but allows termination of membership if circumstances change. Requiring notice of termination

of the agreement warns the center that its budget will change for the next fiscal year and gives an opportunity to reverse the decision.

Publication policy. Research which results in intellectual property is a relatively small part of a center's total output, yet a great deal of time and effort go into negotiations over publication delays and patents. Although variations exist, all NSF I/UCRCs provide some mechanism for delay of center publications. A typical arrangement allows members to request a 3- to 12-month publication delay in order to permit filing of patent applications (see Figure 3-6). Many centers routinely follow this procedure. If the delayed publication involves a student's thesis or dissertation, the student can complete his or her degree but the thesis is withheld from the library for a limited period. According to our research, few faculty have experienced significant publication delays under this system (Gray and Meyer, 1994).

Intellectual property issues. In virtually all I/UCRCs, patents and copyrights belong to the university. NSF waives all patent rights but retains "march in rights"⁵ in PL98-620, and industry spon-

Figure 3-6 Typical publication procedure in center bylaws.

1. Submits copy of center-funded manuscript for review by the IAB prior to publication with an approval form.
2. IAB member must request publication delay within 30 days or the manuscript is approved.
3. To delay publication, the IAB member must ask that a patent disclosure be pursued.
4. University must file a patent disclosure and pursue patent or license.
5. All industry members will be asked to support patent filing cost.
6. Only IAB members who agree to support filing cost will retain non-exclusive royalty-free license.

⁵If a patent is granted and is not utilized for a number of years, the government may go to court to determine if it is in the public interest to utilize it. No such action has been initiated in the 24-year history of NSF I/UCRCs.

sors receive royalty free non-exclusive license to practice and use the invention. Policies vary on who pays for the patenting costs, whether rights are retained if a firm chooses not to share filing costs, and the ability of a sponsor to transfer patents to subsidiaries and non-subsidiaries. Since some IAB members have argued that requiring non-exclusivity of all intellectual property undermines technology transfer (see discussion in Chapter 9) some centers have negotiated mechanisms which allow exclusive but royalty-bearing licensing arrangements under certain circumstances.

Bylaws

Bylaws relieve the membership agreement of important but overly complex procedural details. Bylaws also describe structural or procedural issues which require a fairly high level of formality. The level of detail in the bylaws depends upon the needs and comfort level of the various stakeholders. Some centers and their IAB members prefer to have all major organization and operational issues detailed in the bylaws, others prefer no bylaws, and some want bylaws that address only a few issues and provide much less detail.

As Figure 3-7 illustrates, most I/UCRCs take an intermediate approach by describing all organizational chart functions, mentioning significant operational issues, and providing details only where needed. Significant operational issues include membership rights and privileges, different types of center research and the mechanisms for supporting single or multiple-firm enhancement projects or proprietary contracts, a schedule for required reports and regularly scheduled meetings, and other procedures. The

Figure 3-7 Elements of typical center bylaws.

Organization: Where center reports within the university, authority for decisions, descriptions of functions, committees, roles, and research areas projects.

Categories of Membership: Rights and privileges of different membership levels.

Operating procedures: Schedule, expected reports, meetings (semi-annual, strategic planning), types of research projects, technology transfer mechanisms, center sabbaticals, financial and budgetary guidelines, fees, and rights related to use of equipment and testbeds.

Appendices: An organizational chart, a description of the research areas, and calendar of regular events.

bylaws or membership agreement should specify a procedure for amending them.

Internal Center Operations

Centers may be able to take a minimalist approach to explicit formalization of internal operations for at least two reasons: centers tend to be small organizations and have personnel with a high level of professionalism. Nonetheless, all centers must be consistent and predictable with a myriad of complex commitments and transactions. Since functions and activities vary considerably, the challenge is which functions and activities can benefit (and which will not) from formalization and by which mechanisms.

Role Descriptions

Active participation in center tasks by departmental faculty members and managers in industry are critical to the center's success. Unfortunately, it's easy for busy faculty or industry representatives to forget or neglect these responsibilities. Faculty should contribute to recruiting efforts and industrial monitors should transfer technology. When they don't, written role descriptions can be a very effective vehicle for reinforcing specific responsibilities. Descriptions of responsibilities provided in this Chapter may be the starting point for developing these descriptions.

Policies and Procedures

Policies (general guidelines) and procedures (sequential steps for accomplishing work) standardize organizational behavior. They are appropriate for use with at least two kinds of activities: activities which can and should be routinized and made as predictable as possible; activities where there is a proven and effective way—a best practice. They can be informal or understood and still be best practices. Unfortunately, a significant number of centers and staff either never hear or misunderstand when policies and procedures are left undocumented. This is part of the motivation behind this volume. We recommend committing instrumental policies and procedures to writing and publishing them in a center policy and procedures manual. This manual should be widely circulated in an easily accessed notebook. Care should be taken to ensure that the contents be critical to center efficiency and effectiveness, and that they avoid needless bureaucracy. (See Figure 3-8.)

Figure 3-8 Suggestions for center policies and procedure manual.**Routine University Procedures**

- Travel Approval
- Changes in Budgets
- Equipment Acquisition
- Release Time Approval

Routine Center Procedures

- Development of Enhancements and Contracts
- Publication Approval
- Patent Disclosure
- Succession and Appointment of Directors

- Record keeping for Research Projects, Research Notebook

- Programming Language and Documentation Levels

- Proposal Submission (format, deadlines, etc.)

- Reports Preparation (format, deadline, etc.)

I/UCRC Best Practices

- Meeting Agenda

- Soliciting Feedback on Proposals

- Proposal Screening and Selection

- Recruitment Protocol

SUMMARY

For a variety of reasons industry and universities find it difficult to engage in intense and ongoing research cooperation. Fortunately, I/UCRCs can serve as a bridge between actors in these two sectors, opening the doors to meaningful interaction. However, designing organizational bridges between industry and universities, two very different and often conflicting organizations, is a challenging assignment for I/UCRCs. Like their physical counterpart, organizational bridges depend upon their structural integrity. In this chapter we've tried to provide the reader with a blueprint and some contingency for developing and implementing a sound infrastructure for cooperative research.

The I/UCRC prototype is a relatively simple yet organic structure. Its success depends upon responsive and appropriately coordinated administrative, research, and external linkage functions, fulfilling many roles and decision-making systems tailored to local circumstances.

In spite of the fact that we've presented a prototype structure, it's worth reminding our readers that the most important rule of organizational design is structure and must be tailored to local circumstances. Clearly, the reader is encouraged to take our recommendations and "reinvent" our prototype. If this is the case, why even offer a prototype? There are several reasons. First, and

most importantly, most universities will confront similar circumstances and the I/UCRC model has been successfully replicated over and over. Over 75 universities, at last count. Clearly, the core features of the model are both robust and effective. In addition, this model provides a good foundation for creating more complex and sophisticated structures. We discuss structural variations on the basic I/UCRC model in Chapter 11.

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APPENDIX 3-1**Issues Addressed in Typical Industry-University Legal Agreements⁶**

1. Number of projects.
2. Administrative structure of projects.
3. Time period of agreement.
4. Provision for continuation of agreement.
5. Extension of projects if contracts are not continued.
6. Method of selection and approval of projects.
7. Ratio of basic research to applied research.
8. Provisions for interaction between scientists.
9. Independent review of research projects.
10. Formula for adjustment of corporate funding for inflation or deflation.
11. Title to equipment purchased with sponsor's funds.
12. Publication restrictions on university researcher.
13. Ownership of patents and technical developments.
14. Protection provided for university proprietary information.
15. Protection provided for sponsors proprietary information.
16. Obligation of sponsor to commercialize research results.
17. Sponsor to monitor research for patentable and novel inventions.
18. Prompt reporting and filing for patentability by sponsor.
19. Prompt reporting of possible results by university sponsor.
20. Who files for patent.
21. Who files for foreign patents.
22. Who pays cost of patent filings and prosecution.
23. Is prosecution beyond patent office rejection required.
24. May university use independent patent counsel.
25. Royalty to university adjusted, based on contribution of sponsor.
26. University to provide records for patent application.
27. University to assure title to all technical developments.
28. University waiver of patent claim against sponsor.
29. Individual inventor waiver of patent claim against sponsor.
30. Indemnification clause for claims arising from patent claims.
31. University agrees to grant licenses to sponsor.
32. Exclusive license on patentable inventions to sponsor.
33. Licenses on non-patentable technical developments to sponsor.

⁶Adapted from Reams, 1986.

34. Licensing of non-program patents by university to sponsor.
35. Licensing requirements specified in agreement.
36. Reasonable attempt to be made by sponsor to market research results.
37. If reasonable attempt not made by sponsor to market results, the non-exclusive sublicense results.
38. Industry sponsor required to submit marketability schedule during period of exclusive license.
39. Sponsor permitted to sublicense.
40. Royalty payments by sponsor to university.
41. If no royalty rate agreement, arbitration is provided.
42. Law to be applied to agreement.
43. Action to be taken in event of infringement.
44. Who may sue infringer?
45. Infringement suit cost recovery.
46. Has university right of approval prior to sponsor bringing suit?
47. University may assign title to sponsor bringing suit.
48. Right of university to license elsewhere if sponsor does not elect to license.
49. Termination of agreement for breach or default.
50. Termination for insolvency of a party.
51. Patent and license rights survive termination of agreement.
52. Indemnification of university by sponsor for liability arising from use of products.
53. University warrants sufficient insurance and workers' compensation for its employees.
54. Sponsor to hold university harmless for sponsor's employees injured at university.
55. Assignment of rights and obligations by either party.
56. May university subcontract.
57. Use of university or sponsor's name with publicity.
58. Research participant non-disclosure agreement.
59. Distribution of product by university for research only.
60. Third-party competitor distributes similar product, significantly affecting sponsor's business, then royalty payment to university may cease.
61. Repayment of sponsor's costs required at termination of agreement.
62. Provision for alternative funding to university.
63. Contract funding stated.
64. Designated director of research or principal investigator.
65. Provision for resolution of disputes.

APPENDIX 3-2
Sample I/UCRC Membership Agreement.

Industry/University Cooperative Research Center for _____

This agreement is made this ____ day of _____, 19__ by and between The University of _____ (hereinafter called "UNIVERSITY") and _____ (hereinafter called "COMPANY").

WHEREAS, the parties to this Agreement intend to join together in a cooperative effort to support a Industry/University Cooperative Research Center for _____ (hereinafter called "CENTER") at the UNIVERSITY to maintain a mechanism whereby the UNIVERSITY environment can be used to perform research to _____.

The parties hereby agree to the following terms and conditions:

A. CENTER will be operated by certain faculty, staff and students at the UNIVERSITY. For the first four years the CENTER will be supported jointly by industrial firms, federal laboratories, the National Science Foundation (NSF), the state and the UNIVERSITY.

B. Any COMPANY, Federal Research and Development organization, or any Government-owned Contractor Operated laboratory may become a sponsor of the CENTER, consistent with applicable state and federal laws and statutes. Federal Research and Development organizations and Government-owned Contractor Operated laboratories may become sponsors of the CENTER on terms and conditions other than those in this agreement upon approval by UNIVERSITY and two-thirds of the Industrial Advisory Board.

C. COMPANY agrees to contribute \$_____ annually in support of the CENTER and thereby becomes a sponsor. Payment of these membership fees shall be made to the University of _____ as a lump sum effective _____, or in four equal quarterly installments on _____, _____, _____, and _____ of each year of sponsorship. Checks from COMPANY should be mailed to _____ and made payable to _____. Because research of the type to be done by CENTER takes time and research results may not be obvious immediately, COMPANY

should join CENTER with the intention of remaining a fee paying member for at least two years. However, COMPANY may terminate this Agreement by giving UNIVERSITY 90 days written notice prior to the termination date.

UNIVERSITY agrees to contribute indirect charges related to the membership of industrial and federal members of the CENTER. The results of CENTER research will be made equally available to all sponsoring companies. Ownership of patents and copyrights that result from CENTER research will remain with UNIVERSITY, as per the terms of this Agreement.

D. The organization and operation of CENTER will be specified by CENTER bylaws that will be adopted at the first Industrial Advisory Board meeting. The bylaws, when adopted, will become part of the Agreement.

E. There will be an Industrial Advisory Board composed of one representative from each member. This board makes recommendations on (a) the research projects to be carried out by CENTER, (b) the apportionment of resources to these research projects, and (c) changes in the bylaws. The operation of this board is specified in the bylaws.

F. UNIVERSITY reserves the right to publish in scientific or engineering journals the results of any research performed by CENTER. COMPANY, however, shall have the opportunity to review any paper or presentation containing results of the research program of CENTER prior to publication of the paper, and shall have the right to request a delay in publication for a period not to exceed one (1) year from the date of submission to COMPANY, for proprietary reasons, provided that COMPANY makes a written request and justification for such delay within sixty (60) days from the date the proposed publication is submitted by certified mail to COMPANY.

G. All patents derived from inventions conceived or first actually reduced to practice in the course of research conducted by the CENTER shall belong to UNIVERSITY. UNIVERSITY, pursuant to chapter 18 of title 35 of the United States Code, commonly called the Bayh-Dole Act, will have ownership of all patents developed from this work, subject to "march-in" rights as set forth in this Act. COMPANIES that were sponsors at the time of disclosure and wish to exercise rights to a royalty-free license agree to pay for the costs of patent application. UNIVERSITY agrees that

all such CENTER sponsors are entitled to a nonexclusive royalty-free license. COMPANY will have the right to sublicense its subsidiaries and affiliates. If only one COMPANY seeks a license, that COMPANY may obtain an exclusive fee-bearing license through one of its agents. COMPANY has the right to sublicense its subsidiaries and affiliates.

H. Copyright registration shall be obtained for software developed by CENTER. COMPANY shall be entitled to a nonexclusive, royalty-free license to all software developed by CENTER. COMPANY will have the right to enhance and to re-market enhanced or unenhanced software with royalties due to CENTER to be negotiated, based on the worth of the initial software, but not to exceed ____% of a fair sale price of the enhanced software product sold or licensed by COMPANY.

I. Any royalties and fees received by UNIVERSITY under this Agreement, over and above expenses incurred, will be distributed as follows:

- (1) ____% to inventor, or in accordance with UNIVERSITY royalty-sharing schedule,
- (2) ____% to the University of _____, and
- (3) ____% to CENTER operating account, or to the College of _____ in the event that CENTER is no longer in operation.

J. Neither party is assuming any liability for the actions or omissions of the other party. Each party will indemnify and hold the other party harmless against all claims, liability, injury, damage or cost based upon injury or death to persons, or loss of, damage to, or loss of use of property that arises out of the performance of this agreement to the extent that such claims, liability, damage, cost or expense results from the negligence of a party's agents or employees.

	UNIVERSITY	COMPANY
Name	_____	_____
Title	_____	_____
Signature	_____	_____
Date	_____	_____
For	_____	_____

