

EXPANDING AND DIVERSIFYING THE CENTER RESOURCE BASE

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INTRODUCTION

Centers are run as small entrepreneurial enterprises of the university. Like all small enterprises, a center's health and vitality depend on the availability of a variety of resources, particularly technical and financial. We have discussed the importance of developing your center's technical and human resources previously (see Chapters 5 and 6). In this chapter, we focus on the importance of financial resources and how to develop them.

There's a variety of reasons centers must focus a considerable amount of organizational time and energy on developing and implementing strategies for financial growth and diversification. First, most new centers start operations as relatively small research organizations. A first-year NSF I/UCRC typically begins operating with a budget of less than \$500,000. This falls well below the level needed to sustain a cutting-edge, multi-disciplinary and team-based research organization, particularly one which aspires to national or international excellence. In addition, data indicate that the average 10-member center loses approximately one member each year. Centers also lose federal and state support. Unfortunately, this pattern holds true for even the best run centers! Thus, a strategy of growth and diversification is critical to both new centers which aspire to reach a financial and technical

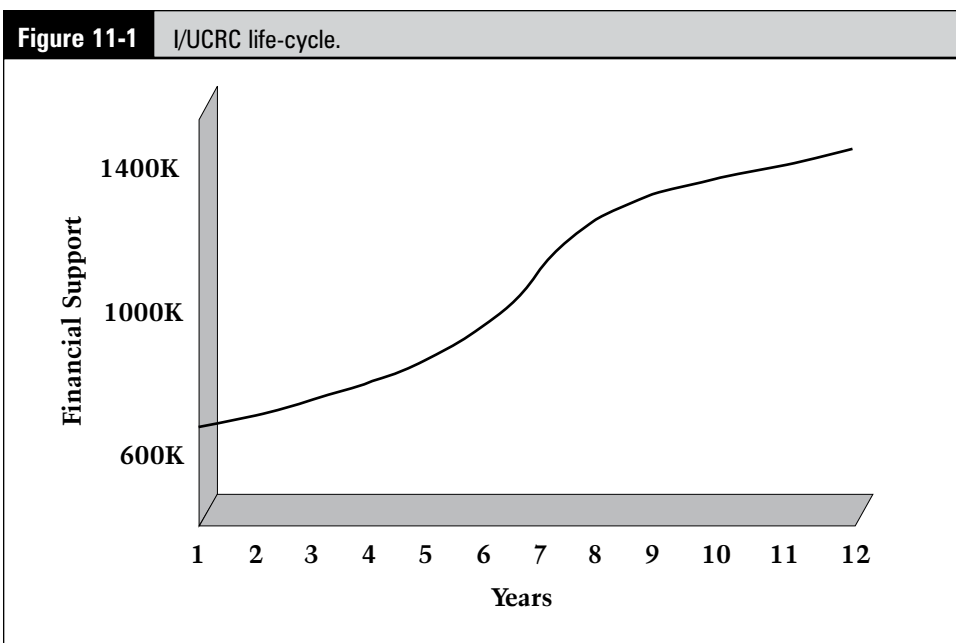
critical mass and mature centers which hope to forestall decline and organizational extinction.

The centrality of growth to organizational survival is not unique to centers. Virtually all organizations confront this issue, but fortunately there are a number of standard strategies for achieving a proper balance between growth and organizational health.

LIFE CYCLES, GROWTH AND COOPERATIVE RESEARCH

The need for organizational growth is widely recognized. Most organizations go through fairly predictable patterns called life-cycles which can be depicted by an S-shaped curve. While some organizations may be able to stay small and continue operating for an extended period, most organizational survivors generally follow a pattern characterized by period of introduction, followed by a period of growth, followed by a period of maturity, followed almost inevitably by a period of decline. Thus, organizations which want to survive long-term need to develop strategies to achieve growth and other strategies to sustain them as long as possible.

This is true for cooperative research centers. Centers are competing with other universities and research labs for a limited number of customers. A life cycle model shows how surviving centers grow over time. Figure 11-1 illustrates an NSF I/UCRC life-cycle.



Centers under two years of age have an average budget of \$680,000. By the time a center is five to six years old, its average budget increases to \$900,000. After eight years the average budget rises to almost \$1.4 million.

Thus, long-term financial prospects for a new center with only \$500,000 to start, are much brighter. Much brighter that is, if they can avoid complacency and develop a winning strategy for growth.

Strategies for Growth

According to Galbraith and Kazanjian (1986), there are four basic growth strategies: expansion of volume, geographic dispersion, vertical integration, and diversification.

Each of these strategies either expands the customer base directly or diversifies products or services to add new customers. Expansion by volume usually involves marketing or pricing efforts for your current product or services. Geographic dispersion involves attempts to add customers by locating a branch or franchise a distance away from your current market (for your current product or services). Vertical integration involves attempts to grow by offering new but highly related products or services. Diversification involves attempts to grow by offering products or services that are unrelated to what you currently offer.

While Galbraith and Kazanjian's framework is based on profit-making organizations, most of these strategies work for I/UCRC growth, with the exception of diversification to completely unrelated services. Centers grow by marketing or pricing strategies that expand the volume of customers for their current services (expansion by volume); or by developing a branch at another campus (geographic dispersion); or by offering new but highly-related services like applied research, development or even testing (vertical integration).

Selecting a Strategy

Choice of the correct growth strategy isn't always straightforward. It depends upon awareness of opportunities and needs which exist in your environment, like new sources of funding, technological developments, new markets, etc. Centers operating in industries which need precompetitive research or which face little competition from other research providers have a good opportunity for growth. Awareness of these needs and opportunities is important. In choosing a growth strategy it is crucial to obtain such informa-

tion as which segments of the target industry are growing or declining, needs for R&D, willingness of firms to procure R&D outside organizational boundaries, university's expertise and industrial networks, and federal and state initiatives. We have discussed approaches to collecting this kind of information elsewhere, and encourage the reader to review this material (See Chapters 2 and 5).

Strategies need to be selected based on your ability and willingness to implement them. For instance, any growth strategy will require your organization to expend resources, in the form of time or money. If a center isn't willing to expend time or money in pursuit of growth, its strategy is doomed to fail. In addition, the more the strategy differs from current customers and services, the more difficult it will be to implement. Thus, if a center doesn't have the talent and skills needed to implement new services, it would be better advised to choose a simpler strategy.

Different growth strategies require different organizational structures. A center needs to be willing and able to change and adapt its organizational structure to conform with the needs of a given strategy. For instance, geographic dispersion and vertical integration will require more complex and managerially intense structures than is typical of a one-site or single service center. The greater the change, the more organizational redesign one may need to engage in. When selecting a strategy, anticipate structural changes, such as more division of labor or greater coordination, and assess your willingness and ability to execute them.

The imperative for growth is important but it entails risks too. Strategies that exceed organizational capabilities waste precious resources and risk chaos and decline. Galbraith and Kazanjian (1986) argue that the overriding principle for growth should be one of "controlled diversity." That is, expand and diversify the market and services in a way that strengthens and reinforces, rather than dilutes and weakens core competence.

This is particularly relevant to fragile boundary-spanning I/UCRCs. Growth should not be pursued as an end, but as a means of achieving the financial and technical critical mass necessary to make an impact in a focused area of research. Centers that understand and heed this dictum can capitalize on the opportunities which exist in their environment at various points in their life-cycle. Centers that don't, risk diluting or neutralizing the very qualities (e.g., a focused and cohesive research program, small personal and informal organizational structure) that have attracted and sustained current membership.

STRATEGIES AND TACTICS FOR CENTER GROWTH AND DIVERSIFICATION

Once a center has built a solid foundation with a membership-based industrial consortium, a savvy administrator can choose a number of strategies to achieve growth. These strategies are organized into three main categories: expansion by volume, geographic dispersion, and vertical integration. Figure 11-2 lists the specific approaches within each strategy.

Figure 11-2 Strategies for growth and diversification.

Strategy	Approach
Expansion by Volume	Raising Membership Fees Developing Research Enhancements Adding Members and Grants Small Firms Federal Agencies Non-Profits and Associations Traditional Grants
Geographic Dispersion	Informal Time-Limited Partnerships Formal, Ongoing Partnerships
Vertical Integration	Providing Educational Services Providing Research-Related Services

Expansion of Volume

Expansion of volume involves attempts to increase a center's revenue without changing its precompetitive fundamental research. This does not mean that the center's research portfolio remains static. As discussed in Chapter 5, a center's research program must change and evolve.

Expansion by volume doesn't require significant resources, new services or major organizational changes. It is simple and straightforward. Growth is slow and incremental rather than fast and dramatic.

Typically, I/UCRCs expand the volume of work by increasing revenues from current members, and/or adding new members or

sponsors. While some of the approaches we discuss here may have been used during your center's initial or ongoing recruitment effort, we think they warrant a brief review.

Increasing Work and Revenues from Current Members— Pricing Strategies

All NSF I/UCRC Centers set annual membership fees. One growth strategy is simply raising the fee. For instance, a Center with ten members at \$30,000 per year would reap \$50,000, a 17 percent increase, by raising its fee to \$35,000. Strictly speaking, this is not an increase in volume, but it is a fairly common strategy for increasing revenues. By 1994, ten of the 18 oldest I/UCRCs (average age of nine years) raised their fees, seven maintained the same fee and one lowered its fee. The average fee increase was \$7,500.

Relevant issues. This approach is fairly simple (at least on the surface). Negotiations are limited to the current membership, not an unlimited number of recruits, and results in a predictable increase in the center's revenues.

Unfortunately, unless your center enjoys a monopolistic position in its environment, this approach isn't as simple or as straight forward as it first seems. In order to increase its membership fee, a center must overcome a number of obstacles, not the least being that this strategy doesn't appeal to budget-conscious IAB members as much it does to overworked directors. The reality is IAB members often find it difficult to justify increased fees at a time when most budgets are getting slashed. Complicating this is the fact that a change in your membership rate often involves preparing a new membership agreement and bylaws and a new round of approval and signatures from upper level management and corporate lawyers. This prospect alone has been enough to terminate further discussion.

In addition, since an individual member may quit rather than pay an increased membership fee, a center needs near unanimous endorsement. A fee increase of 20 percent won't do much good if some members resign!

Because of all of these constraints, experience suggests all but the best-prepared proposals for a membership increase never get past the discussion stage and usually result in a recommendation for a renewed membership drive.

Recommended strategy. In spite of these cautions, some centers have succeeded in raising their membership fee. If this approach makes sense, here are a few suggestions on how to succeed.

1. *Do your homework:* Proposals accompanied by the following kind of facts and figures supporting an increase are more persuasive: number of years the center has operated with current fee; effect of inflation on the current fee; changes in technology, etc. that make operations more expensive; comparable costs including relevant overhead rates and related costs of salary, equipment, technicians for doing research within firms or charged by competitors; and level of time and effort for recruitment. Keep in mind most members will need to evaluate the cost/benefit of their past investments. Therefore, if possible, data about center-related benefits (see Chapter 8) should be presented to strengthen your proposal.
2. *Emphasize real consequences:* A most powerful argument for a fee increase is its effect on the matching dollars the center receives. Centers at risk for falling below minimum cost-sharing for a government sponsored program (\$300,000 for NSF) have a good argument.
3. *Develop grassroots support:* Every director should have champions within the IAB to mobilize on behalf of a fee increase. A proposal for a membership fee increase presented by an IAB member is more persuasive than one by the director. Directors are also cautioned that even losing a single member who cannot convince his managers on the value of the increase can wipe out benefits from it.
4. *Time changes to coincide with other agreement changes:* Even if members support a fee increase, many will delay a change in fee rates until membership agreements are up for renewal or are being modified to limit attorney involvement. One center has solved this problem by institutionalizing fee increases into their membership agreement as a schedule of fee increases negotiated by upper management only once, at signing. Center membership agreements and bylaws can also be written to allow fee changes by a simple majority vote.

Research Enhancements

Some Center Directors are reluctant to approach current members about supplemental funding but should recognize that firms join an I/UCRC to buy rather than produce some of the research

it needs. Once a good relationship develops and other research needs arise, IAB members are comfortable purchasing additional research. In fact, pursuing supplemental support from one's members is one of the most effective strategies for expanding your center's resource base. In 1993-1994, NSF I/UCRCs received \$5.5 million (roughly 11 percent of their budget) in supplemental support. In fact, 75 percent of I/UCRCs get supplements and seven centers get more support from supplements than from membership fees! Support may be an enhancement project or a contract. Contracts usually are applied research for a single customer (see section titled Providing Research-Related Services in this chapter) and are managed outside the center.

Relevant issues. An enhancement is any project supported by supplemental funding consistent with the center's core research program, either fundamental or applied. Because the work is so similar to core research, centers can usually engage in enhancement research under the scope of center agreements and organizational structure.

Enhancement projects can come about in a number of ways. Examples include a project without support from the general membership but of high interest to one or more firms; accelerating or expanding an existing project; or a project idea put on a fast track. Enhancements involve much more intensive member-PI interaction. At one center with a great deal of enhancement activity, IAB members threaten to quit if worthwhile enhancements can't be developed.

Recommended strategy.

1. *Provide a routine and friendly administrative foundation:* Members don't want to waste their time waiting for paperwork to make its way through two bureaucracies before they can get an enhancement project started. Be sure your membership agreement and bylaws address enhancement and contract projects. To encourage enhancement support, most universities apply the center's reduced overhead rate as long as findings and intellectual property will be shared with all members.
2. *Encourage faculty to develop enhancement projects:* While some enhancements just happen, faculty need to be alerted to the potential for support and encouraged to develop new

projects which can be marketed as such. The best way is for faculty to talk to IAB members about their needs.

3. *Encourage IAB members to approach the I/UCRC:* At the same time, members need to be encouraged to come to the center and approach faculty with their research needs and ideas.
4. *Institutionalize enhancements into the research process:* If steps 2 and 3 succeed, enhancements will become an integral part of all your research planning, development, selection, and reporting activities. Enhancements should be specified in all calls for proposals, and research reviews. Core proposals that don't garner enough support, should be marketed routinely as enhancements.

Adding New Members and Grants

Recruitment of new members must be a central and ongoing part of any center's growth plan. In this section, we briefly highlight how to focus your recruiting efforts and discuss how some centers have increased their membership by targeting a number of non-traditional audiences including: small firms, government members and industrial associations.

Intensive Recruiting Campaigns

Successful directors recruit as an integral part of weekly duties, but there are also advantages to periodic intensive marketing or recruitment campaigns. It makes more efficient use of time, trips out of town, or trips to your labs, and such effort is a catalyst for reviewing and updating center marketing materials. Involvement of your center's faculty and board members can be refreshed during intense recruiting campaigns.

An intense marketing or recruitment campaign basically involves a smaller scale reprise of the efforts your center undertook when it recruited its first cohort of members: using one's network and other resources to identify prospects and contacts; revising and updating recruitment materials; qualifying and targeting prime prospects and organizing a group meeting. Since these steps were described in detail in Chapters 2 and 4, we will not repeat them here.

On the other hand, there are two important and related differences one should keep in mind when planning and implementing a recruiting campaign as an established center. First, you no longer

need to sell your center based on its promise but, instead, should sell it based on its accomplishments. Therefore, devote time to systematically cataloging your center's scientific and technical accomplishments and recruitment advantages for members. This should be an important and early task. Remember that there is no better sales tool than a satisfied customer. Furthermore, it's absolutely imperative that you secure the help and involvement of your current members in selling the benefits of membership during your recruiting meeting. In some centers, industry members provide contacts and recruit specific members.

Small Firms and a Multiple-Level Fee Structure

Often membership prospects are interested in joining but just can't afford the established membership fee. More often than not, these firms meet the definition of a small business. In order to overcome the financial barriers to membership by this segment of your potential customer base some centers implement a lower secondary, tertiary, or sliding scale fee levels for associate membership. In 1994-1995, 16 of the 55 NSF I/UCRCs had a multiple fee structure to allow small firms to join at a reduced fee.

Relevant issues. Lowering the fee to accommodate smaller firms makes sense. First, small firms represent untapped and often technologically innovative markets. In addition, some larger firms value the opportunity to interact with smaller firms, particularly if they have a supplier-manufacturer relationship. Further, state governments often encourage and sometimes subsidize these arrangements making small business participation more valuable to the center.

On the other hand, multiple fee structures add complexity to recruiting, bookkeeping and management. Associate members' goals may differ from other members and can cause conflict within your consortium. Current members may resist subsidizing small members. This problem is probably the most serious. However, as we described in Chapter 3, most I/UCRCs deal with this obstacle by offering associate members abridged rights or benefits like limited voting rights, limited intellectual property rights, or limited access to some research results.

I/UCRC experience shows that reduced fees rarely increases membership significantly. In fact, many of the centers that offer this option have few or no associate members active! A number of factors may account for this. "Your fee is too high" may simply be a polite way of saying "I am not interested." Small firms

may believe that their needs and goals will be overridden by full members, particularly given the restricted benefits that often accompany associate membership.

Recommended strategy. It's important to remember that small companies can be highly innovative and may contribute technologically to your center. If you think a multiple level fee structure may help you recruit some firms, here are a few suggestions on how to succeed.

1. *Clarify your goals:* Implementing a multiple level fee structure can take a significant amount of time. It's important to clarify the reasons for making this change. Do you anticipate a quantum leap in membership? Will this approach court favor (and perhaps revenues) with local or state technology officials? Do you anticipate associate members will add to the technological mix of your membership? If your goals aren't realistic and reachable, you would better be advised to invest your energies elsewhere.
2. *Test the waters with some key prospects:* Before you make a big investment of time, it's probably worth consulting with the firms you hope to recruit. Try to find out if they really believe membership would be possible under a reduced fee, what level of fee would be acceptable, and whether the typical trade-off of fewer benefits for a lower fee is acceptable. Remember you don't want people to tell you what you want to hear. Encourage candid assessments.
3. *Assess the impact of a reduced fee on current members:* Try to anticipate the impact of the new fee on your current membership. How many of them might qualify for and decide to switch to a lower membership fee?
4. *Develop grassroots support:* This change cannot be unilateral. If you are convinced that you have a good chance of achieving the goals you have in mind, it's time to solicit input and mobilize support for your plan among some key IAB members. Use their input to develop a proposal they feel they can get behind. In many cases, this proposal involves some abridgment of rights for associate members on issues like intellectual property, voting privileges, or both.
5. *Schedule changes to coincide with other agreement changes:* Changes to agreements and bylaws and another round of lawyers are necessary so it may make sense to delay until

membership agreements are up for renewal or are being modified.

Recruit, recruit, recruit. Need we say more.

Recruiting Federal and Military Agencies as Members

One of the primary reasons firms join centers is it is a cost-effective way to buy research. The same is true for federal agencies. Recent federal policies and programs encourage transfer of government research and development of dual-use (defense and commercial) technologies encourage centers to recruit actively government agencies as members⁹. Federal entities now account for roughly ten percent of the 700 NSF I/UCRC memberships (about half are military agencies or labs, another 20 percent are national laboratories). Some centers get over half their membership revenues from federal agencies. Sometimes, federal members support a center through multi-year institutional grant. (These are reviewed in section titled *Vertical Integration* in this chapter.)

Relevant issues. As the numbers suggest, the Department of Defense and other federal agencies are a good source of new center memberships¹⁰. Interestingly, representatives of most federal/military organizations find it difficult to sign a center membership agreement. However, this dilemma actually constitutes a competitive advantage for government sponsored I/UCRCs, since federal entities can join by transferring funds via the government sponsor. This is done by a Military Interdepartmental Procurement Request (MIPR) or its civilian equivalent. Many military organizations have significant needs for external research. This mechanism is used by them to transfer several million dollars in enhancement project support to NSF's I/UCRCs.

In addition to dollars, federal members may offer access to specialized equipment, talented personnel, and information on new and emerging technological advances. Further, regulatory agencies may pinpoint critical needs and comment on the value of proposed projects.

There are reasons for *not* recruiting federal agencies. Sometimes military needs (e.g., high performance, small production, high unit

⁹While some of the large-scale dual-use federal initiatives have been scaled back or eliminated by the recent Congress, some Department of Defense initiatives continue.

¹⁰State governments often fund I/UCRCs by becoming sponsors rather than members.

cost) and industrial needs (e.g., modest performance, high production, low unit cost) conflict. Research performed in federal agencies may compete with I/UCRC research for member research.

Recommended strategy. Recruiting a federal member isn't much different from recruiting an industrial member, so we encourage you to review the advice provided in Chapter 4. In addition, we advise you to do the following:

1. *Consult with industrial members:* If your center currently doesn't have any federal or military members, first consult your industrial members to clarify if their research goals are compatible. In one case, industrial members rejected military members. On the other hand, because of federal-industry procurement relationships, IAB members are likely to have good leads for recruiting federal or military members.
2. *Become familiar with MIPR procedures:* Experience indicates that the MIPR mechanism is a plus for federal agencies in joining a center. However, it seems to cause some universities a headache. In addition, MIPRs have been changing of late. Recent or contemplated MIPR changes include a 3 to 4 percent processing surcharge within NSF and additional signature requirements within the transferring organization. Check with NSF and your grants and contracts office on how you should handle MIPRs or interagency transfer of funds.
3. *Recruit, recruit, recruit.* Enough said.

Recruiting Non-Profits and Industrial Associations

Another way for expanding recruitment is targeting non-profit research organizations and industrial associations. Industrial associations include groups like the Electric Power Research Institute and the Gas Research Institute. Unfortunately, according to 1993-1994 data, only one non-profit and seven associations were I/UCRC members.

Relevant issues. There are a number of reasons why non-profits organizations haven't proven to be a significant source of memberships. Most non-profits are *research performers* not research consumers and often compete with I/UCRCs for industry's research support¹¹.

¹¹Non-profits might be recruited by centers performing non-traditional research. For instance, Health Planning I/UCRC, University of Arizona, and Georgia Tech have non-profit hospitals among their members.

In contrast, many industrial associations sponsor research and do very little research internally. However, association membership raises questions. If an association joins a center, do all of its members get access and rights to center results? Should a firm join a center if they already pay dues to an association that is already an IAB member? Strategies for resolving these conflicts include: a membership which limits an association's ability to transfer and retain rights to center results, or to require a significantly larger membership fee. The latter strategy was employed by The Ohio State University (OSU) Center on Welding. It became a multi-million dollar arm of the International Welding Institute for a substantially greater IAB membership fee. However, it eventually severed its ties to OSU.

Recommended strategy. Here are a few additional suggestions.

1. *Choose this approach carefully:* Very few non-profit memberships have been recruited successfully. Be particularly wary of pursuing research non-profits that may view your members as potential customers for their own services.
2. *Consult with your members:* Several centers have succeeded in recruiting industrial associations as members, so they have been able to overcome the obstacles to membership we discussed above. Nonetheless, consult your industrial members on your plans to recruit an industrial association and any accommodation necessary for these organizations to join.
3. *Recruit, recruit, recruit.*

Competing for Traditional Research Grants

Most of the faculty involved in centers have a long track record of successful grantsmanship. Since only a few centers achieve the membership-based support required to fund all of their worthwhile research projects, there's no reason faculty should stop their proposal writing. Based on 1993-1994 data, roughly 20 percent or \$3 million of the \$15 million NSF I/UCRCs received from various federal agencies was generated by traditional single- and multiple-investigator research grants. The balance was generated by institutional awards discussed in section Providing Research-Related Services in this chapter.

Relevant issues. Why would a faculty member submit a grant application from a center and not from his/her academic depart-

ment? If the department and center compete for overhead or prestige, the faculty member is caught in the middle. However, there are a number of good reasons for faculty to submit proposals from a center. Centers have specialized facilities and other technical resources; a reputation and track record that support proposals; grant applications often build on work done by the center team; centers ensure industry involvement and eventual transfer of results; and centers can offer leveraging opportunities.

Recommended strategy. A review of grant writing is beyond the scope of this chapter. Like all grant writing, what usually will succeed is quality, personnel, good ideas and a well written proposal. Here are a few helpful suggestions.

1. *Clarify turf issues:* Conflict between the center and department should be worked out before the proposal is written.
2. *Target promising funding opportunities:* Some agencies and programs will put a greater premium on center-related strengths (e.g., teamwork, multidisciplinary, industry relevance, etc.). You will probably have a competitive advantage when submitting your proposal to these programs.
3. *Facilitate team collaboration:* Center Directors may need to facilitate multi-investigator teams to collaborate on a strong proposal.

Geographic Dispersion—Multi-University Partnerships

Because of their relatively large size, U.S. universities have tended to operate independently when it comes to grant writing and center building. Not surprisingly, most I/UCRCs have involved a single university. However, funding for research is getting tighter. At the same time prospective center members complain about their inability to evaluate, let alone join, all of the university-based or government sponsored consortia. In this new environment, multi-institutional partners can reinforce or expand a center's resource base. Based on 1993-1994 data, 17 of NSF's 55 I/UCRCs involve multi-university partnerships, another 12 are exploring this option, and uncounted others have informal partnerships.

Relevant Issues

Partnerships diversify a center's technical capabilities and offer a broader, deeper, and diverse research program to market to new members. Firms prefer working with nearby universities or indi-

viduals with whom they've worked before. A partner university may already have relationships with organizations reluctant to be recruited otherwise.

Unfortunately, some directors and many university administrators believe partnerships result in cutting the financial pie into smaller pieces as support gets shipped off campus. This mentality is very shortsighted. Centers exist in a very competitive and dynamic environment: members join a center when they believe it provides access to valuable assets and leave a center when it does not. Partnerships, if developed properly, can result in a bigger pie or prevent it from shrinking, or disappearing altogether.

Partnerships are informal or formal. Formal arrangements are more likely to produce significant growth. They also require more effort.

Informal Time-Limited Partnerships

A large number of I/UCRCs expand their technical resource base by inviting faculty from other universities to submit proposals to their IAB, sometimes through RFPs, but more often Center Directors invite select faculty to submit a proposal. Awards are executed with a subcontract to the PI and his/her university. The subcontracting university and PI must agree to the terms of the center's membership agreement and bylaws. (See Appendix 11-1; Sample Agreement). Initially, this requires negotiation and paperwork but once established can be routinized. As Figure 11-3 describes, NSF programs can be used to subsidize some informal multi-university partnerships between NSF I/UCRCs.

Formal, Ongoing Partnerships

A large number of I/UCRC partnerships are formal and ongoing. Sometimes these partnerships are executed when a new center is

Figure 11-3 NSF-supported partnerships: TIE projects and other awards.

NSF is aware of the benefits of multi-university partnerships and can cost-share these arrangements via a number of I/UCRC and NSF programs. For instance, the I/UCRC program will, on a cost available basis, cost-share TIE Projects, projects between two or more I/UCRCs. A number of NSF programs which primarily target under-

graduate institutions (RUI/PUI), historically black institutions; institutions in states with low R&D infrastructures (EPSCOR); and foreign institutions (USAID International Partnerships) have been used to subsidize partnerships. Because all I/UCRCs have similar bylaws, the administrative burden is less in TIE projects.

created. Mature centers are increasingly using partnerships as a growth strategy.

Relevant issues. A new center often arranges partnerships when a prospective government sponsor determines that a single university does not have the technical capabilities and/or industrial network necessary to flourish. Over the years, an increasing number of mature single-university centers have entered into partnerships. This phenomenon is generated by increasing competition for industrial support and a desire for growth.

Recognizing the value of these arrangements as well as the extra administrative overhead involved, NSF provides some financial support. As Figure 11-4 reveals, NSF supports these arrangements if each campus contributes both industrial members and technical capabilities. Similar arrangements may be available within other government programs. Although one university is the prime site, shared management is devised. The organizational arrangements needed to support this kind of operation is discussed in section titled *Strategies and Tactics for Center Growth and Diversification* in this chapter.

Figure 11-4 Guidelines for an NSF-supported partnership.

All Partnerships

1. Each partner university must recruit members;
 - a. Full Partnership (\$50,000 per year): requires at least \$150,000 in membership support
 - b. Associate Partnership (\$25,000 per year); requires at least \$75,000 in membership support
2. Universities operate under a single IAB
3. Universities operate under the same governance
4. Shared management
5. Each site supports the evaluation function.

Partnerships Involving a Previously Supported I/UCRC

1. NSF provides a new five-year award
2. Membership support added by the new partner is spent on that campus for at least two years
3. IAB supports projects without any constraints thereafter
4. Old site receives award plus a \$10,000 supplement when the prime or managing site.

This strategy does not make sense for every center. University administrators are skeptical about the benefits of partnerships. Multi-university centers deal with multiple bureaucracies and require a high level of trust and coordination among their directors. They are also much more demanding administratively. Thus, some universities, particularly large, technically diverse universities, may not consider this alternative. For less well-endowed universities or ones trying to recruit within an industry that is being over-recruited by other universities, this approach represents a viable approach to survival, if not expansion.

Recommended strategy. If you believe your center would benefit from a formal multi-university arrangement, discuss it with NSF. NSF's involvement invariably helps to enhance the center's vitality and does not result in a loss of members. Here are a few suggestions.

1. *Identify appropriate partners:* This is probably the most important step. Informal, time-limited partnerships only demand talented and reliable investigators of interest to you and complementary to your expertise. A formal ongoing partnership requires much more: an institution with a peer program with capabilities and assets complementary to your center's; a university administration which supports partnerships under NSF guidelines; and an entrepreneurial collaborator driven to create a viable center with a strong industrial network, and capable of sharing leadership. Compatibility, mutual respect and trust, and collaboration in planning and managing a multi-site center are prerequisites to success. Every transaction must leave a residue of trust on the part of both parties. Informal partnering can be an effective way of screening for these qualities. If you can't find all or at least most of these ingredients, you are probably going against the tide.
2. *Educate and assist prospective partners:* Potential partners need to understand the benefits of an I/UCRC, what it takes to put one together, how one operates, and NSF's guidelines. Sharing a copy of this handbook might be helpful. However, since you've already created a center you are undoubtedly your potential partner's greatest resource. You must be willing to invest a significant amount of time, spend scarce resources on travel, and engage in a great deal of hand-holding if the partnership is going to succeed.

3. *Gain a commitment:* Experience suggests many would-be partners drop by the wayside when they realize how much work it takes to recruit a half-dozen or so members. Well-intentioned collaborators can eat up a great deal of time before they figure out that they don't have the time or energy to create a center. Get an unequivocal commitment in writing for certain activities and milestones from a collaborator before you invest a significant amount of your time and resources in nurturing a merger. It might be wise to get the same from your collaborator's institution. NSF may provide a planning grant to help underwrite this effort.
4. *Create a sense of urgency:* It is easy to procrastinate without goals and deadlines. A merged center shouldn't involve an open-ended time line. As part of your agreement, agree upon deadlines for developing a prospectus, visiting top prospects, hosting a formal recruitment meeting, and submitting a proposal to NSF. Your semi-annual IAB meetings and NSF's funding cycle help define your timeline.
5. *Start working early on administrative details:* Get started on preparing or revising your membership agreement and other legal documents early because it requires many meetings among university administrators. Appendix 11-2 provides a sample memorandum of understanding (MOU) for a joint center.

Vertical Integration

The third and final strategy for growth, vertical integration, involves offering new but related services to your current or prospective members, both educational and research. Diversification only makes sense for a mature and relatively stable center.

In order for this strategy to be successful, one must not only identify an unmet need in one's environment, but must also possess the skills needed to offer these services and be prepared to make the necessary organizational changes required. How similar or different the new services are to those already offered by your center will determine the level of effort necessary.

Providing Educational Services

Although research is emphasized, centers can also build on their educational capabilities, such as offering industry short-courses for a fee. At least one NSF Engineering Research Center has pur-

sued this strategy and achieved considerable financial success. Several other I/UCRCs have received grants to provide educational services to different student populations for a small incremental increase to a center's resource base.

Relevant issues. Multidisciplinary I/UCRCs have a competitive advantage when competing for educational grants. Figure 11-5 lists a variety of programs within NSF which support educational initiatives. While such opportunities can expand your center's resource base and can be personally and institutionally rewarding, it's important to remember they can also strain your organization's capabilities and dilute a center's ability to achieve its central objectives. As a consequence, centers need to be very cautious in pursuing a growth strategy that involves assuming new and additional educational responsibilities.

A good rule of thumb for evaluating educational activities might be: the more they diverge from I/UCRC objectives and populations and the larger the scale, the more trouble and stress. Graduate education, faculty development, and transfer to industry initiatives that are small in scale and allow sufficient support to contract for needed services and resources are good options. For instance, you should be able to absorb small- and even large-scale educational initiatives for college undergraduates, but even a small scale pre-college program imposes a major administrative burden. Nonetheless, a number of Center Directors have found the personal satisfaction derived from these activities to more than justify the additional workload.

Figure 11-5 Educational and human resource funding in NSF.

Program/Mechanism	Goals
<i>NSF I/UCRC</i>	
Industrial Sabbaticals	Faculty Development
Research Opportunities for Undergraduates	Undergraduate Research Opportunities
<i>NSF</i>	
Pre-College Education	Enhance Pre-College
Combined Research & Curriculum Program	Integrate Research and Education
Minority Research Supplement	Encourage Minority Students

Recommended strategy.

1. *Clarify your goals:* Be clear on your purpose. If having an impact on education is important, pre-college educational initiatives can be very rewarding. If increasing your center's funding-base is, seek other initiatives.
2. *Target promising funding opportunities.* Agencies and programs that value center-related teamwork, multidisciplinary, and industrial linkage will give a competitive advantage to your proposal.
3. *Consider collaborating with educational specialists.* University faculty in curriculum and instruction and related disciplines understand educational needs of non-college populations and are highly motivated to secure funding. It is useful to collaborate with them.
4. *Team up with center members.* Pre-college educational programs provide students and teachers with a broadened perspective on the world of work and the different roles scientists and engineers play in different settings. I/UCRCs have been very successful in funding these programs by gaining support and cooperation of IAB companies.

Providing Research-Related Services

Like educational services, research-related services can vary from relatively congruent to very different from current center services. Below we discuss two strategies for expanding your center's resource base. The strategies differ in terms of the novelty of skills and organizational accommodations they require.

- *Contract Research and Related Services.* Enhancements resemble a center's generic core research, but contract research and related activities (like testing and prototyping), involve applied research and explicit deliverables that are very different from core and enhancements.

Most universities engage in a great deal of contract research and related services and need little advice on how to develop and manage this kind of activity. However, because contracts with center members usually require separate and complex legal agreements, they are administered separately from the center (although some centers will nominally count them in their budget). This works well when research is small in scope and infrequent. If a center wanted to grow by performing a significant amount of contract research, it would need

to consider various structural adaptations (see section titled *Organizational Adaptations* in this chapter).

- *Competing for Multi-Year or Institutional Support.* I/UCRCs shouldn't be dissuaded from competing for large-scale, multi-year institutional awards. Just the opposite. NSF I/UCRCs received about \$17 million from federal agencies and \$6 million from state government, or one-third of their 1993-1994 in multi-year awards. Sponsors of these awards have included Department of Defense, Environmental Protection Agency, Defense Advanced Research Projects Agency, National Institute of Standards and Technology, and various state science and technology agencies. Obviously, I/UCRCs that are interested in expanding and diversifying should consider this funding.

Relevant issues. The reason I/UCRCs have been so successful in competing for large multi-year and institutional awards is that they already possess many of the assets which the sponsor is looking for or developing: specialized facilities and other technical resources (e.g., technicians); a strong technical reputation; an ability to work in multidisciplinary teams; formal involvement by industry; established mechanisms for transfer of results; a culture which accepts timelines and deliverables; and an administrative infrastructure to support large-scale projects. Add to this an established base of support which provides additional leveraging, and I/UCRCs have a real competitive advantage.

However, large multi-year institutional awards can constitute a major organizational challenge for an I/UCRC. The degree of organizational adaptation needed is influenced by how large is the award, how different are the mission and services it mandates, and how different is the mandated mode of operation. Relatively small awards, primarily focused on fundamental research and consistent with a consortial format, require only minor adjustments. Large awards involving job creation, economic development, or new extension services for a single sponsor require major adjustments and perhaps even dissolution of the center. See section titled *Organizational Adaptations* in this chapter.

Recommended strategies. Advice for traditional grants applies here too: target promising opportunities, practice good grantsmanship, facilitate collaboration and team formation. In addition, the following tips should prove helpful.

1. *Get the support of your IAB:* Not every funding opportunity synergizes your center's mission. Individual faculty must pursue any funding opportunity which interests them, but IAB may object to some large-scale projects as counter-productive or a dilution of effort. It would be wise to seek their advice and support. Initiatives like the Advanced Technology Program require industry involvement or leadership as a given.
2. *Consider partnering with other universities and non-profits:* Research sponsors expect a big, more technologically diverse bang for their buck. As a consequence, many require or expect proposals to include teams brought together from across several universities and/or not-for-profit research institutes.
3. *Seek advice and pay attention to review criteria:* Because these awards frequently have non-traditional grant objectives like job growth or economic development, many faculty will be out of their element in preparing a winning proposal. Close and frequent contact with the program manager and collaborators who have competed for these kinds of awards is highly recommended.

ORGANIZATIONAL ADAPTATIONS

As we have pointed out in Chapter 3, Organizational Structure, and at the beginning of this chapter, an organization's structure must be designed contingent on a number of contextual factors including: its size, the kind of work it performs, its environment, its strategy and goals, and its culture. Since growth has the potential to change most, if not all, of these factors, growth-oriented Center Directors must be prepared to re-engineer their center's structure in terms of its complexity, centrality or formality. In this section, we review the ways growth affects center structure. A review of the organizational structure can be found at the beginning of Chapter 3.

Increased Size

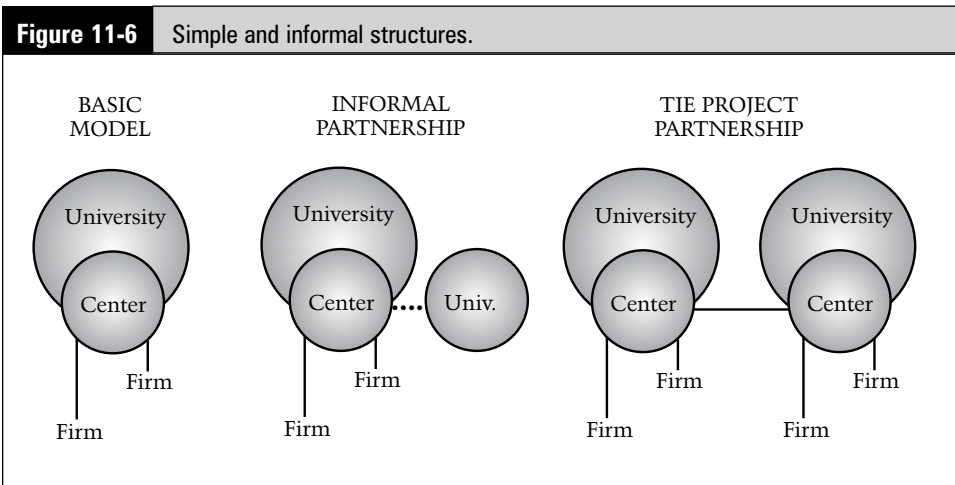
When a center grows it is supported by more members and is doing a larger volume of research. Size is the easiest growth-related change to accommodate organizationally. One can simply add more administrative and research capacity. For instance, cen-

ters have added a full-time director, another secretary, a full-time administrative assistant, or more researchers.¹²

Increased size may also dictate changes in the center's complexity. This is usually accomplished by deepening its hierarchy (vertical differentiation) and/or increasing the division of labor (horizontal differentiation). For instance, with respect to hierarchy, some larger centers create an IAB executive committee or add associate directors. With respect to division of labor, some larger centers have created a variety of associate director positions (e.g., technical, administrative, technology transfer), created or added to their program areas, and created new roles like computer technicians or research associates. As we will discuss in the next section, increased differentiation requires greater coordination.

Multi-University Partnerships

The degree of formality involved in a multi-university partnership influences how much and what kinds of organizational accommodations need to be made. Informal partnerships that involve subcontracting projects or a single joint project can usually be handled by a minor increase in organizational formality in the form of a contract or memorandum of agreement. Figure 11-6 presents a diagram of basic and informal partnerships.



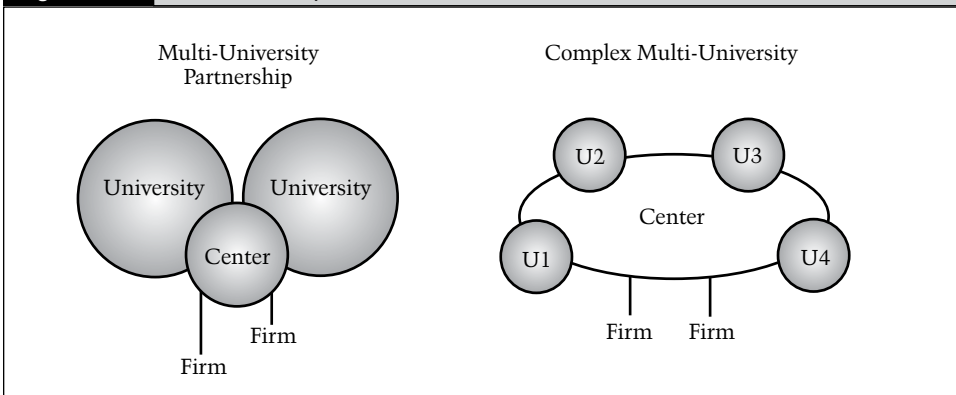
¹²If a center did not have the ability to add research capacity in-house, they might need to hire more faculty for in-house research or engage in the kind of multi-university partnership we discuss below.

Formal multi-institutional partnerships need to identify who is in charge, how decisions are made, how resources are divvied. Most structural changes are administrative. Figure 11-7 presents a diagram of simple and complex arrangements. For instance, multi-university centers usually become more complex in terms of hierarchy and division of labor. Almost inevitably, this means establishment of director, co-director, rotating, or site-director positions and a certain amount of decentralization of decision making.

To promote integration and synergy in the research program, NSF has discouraged completely decentralized units and prefers a single Center Director with site- or co-directors elsewhere. In order to accommodate the increased complexity and need for coordination, most centers adopt greater organizational formality through explicit job descriptions, written policies and procedures, and written agreements between institutions. Research continues to operate in a much less formal fashion.

The biggest challenge presented by a multi-university center's increased complexity and decentralization is how to achieve coordination without sacrificing flexibility and efficiency. In many instances, policies and procedures can be used to spell out areas where site directors have discretion and areas where directors must reach a consensus. For instance, should a site director be able to authorize participation of his/her site in a new proposal or must all new initiatives include both sites? At least one multi-university center found its sites competing with each other for an award for lack of a policy in this area. On the other hand, promulgating policies requiring shared decision-making on all issues

Figure 11-7 Multi-university structure.

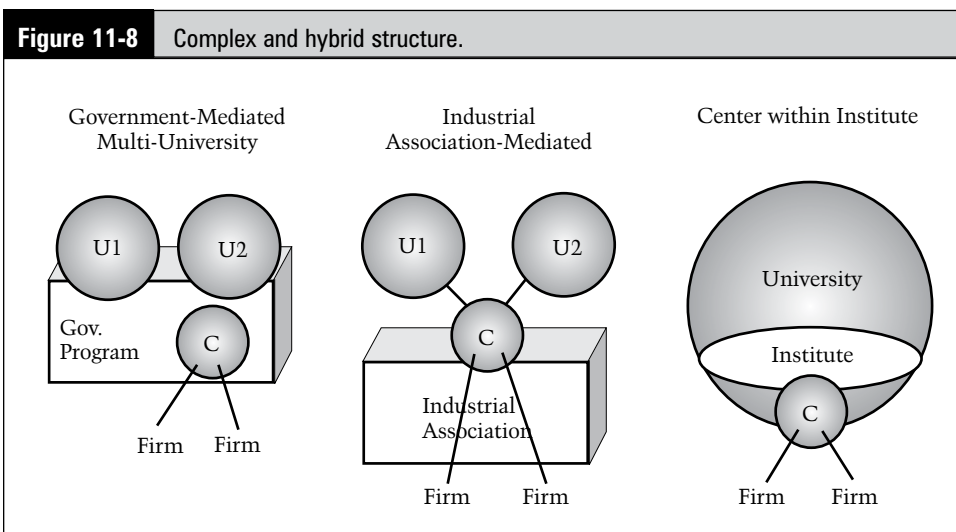


would be time-consuming and inefficient. In the final analysis, effective communication and a degree of trust between sites would probably be a good substitute for excessive reliance on policies and procedures.

Different Missions, Services, and Formats

An I/UCRC has three primary missions: fundamental research that has industrial relevance, enhance graduate education, and promote knowledge and technology transfer to industry. It attempts to achieve these goals by conducting and transferring industry-relevant fundamental research, much of it performed by graduate students, to a consortium of firms. However, multi-year institutional awards, particularly those sponsored by states and some newer federal initiatives, encourage or require recipients to pursue other missions, deliver very different services, and respond to the needs of a single sponsor. While these mandates are not inherently inconsistent with the goals of an I/UCRC, they may represent significant diversifications of a center's operations and create conflicts or overloads which require revising and perhaps reinventing a center's structure. Figure 11-8 presents a diagram of complex and hybrid structures.

When service, mission or format changes are minor, centers may implement many of the structural changes already discussed. For instance, create new roles or functions, centralize decision making more, or modify or add new policies or procedures.



Dramatic changes in services, mission, or format requires more complex multidivisional organizations. For instance, most universities do not reward faculty for contract research or extension work. As a consequence, centers that perform a significant amount of contract research or extension might develop separate units or divisions staffed by full-time non-faculty researchers for this research (Figure 11-9). Similar strategies could be followed for grant-related educational services.

Centers can pursue a strategy of horizontal differentiation even further by creating separate, but loosely-coupled organizations. Perhaps the best example of this model is the collection of centers, institutes and labs which evolved from New Jersey Institute of Technology's (NJIT) Center for Hazardous and Toxic Waste Management, since renamed the Center for Environmental Engineering and Science.

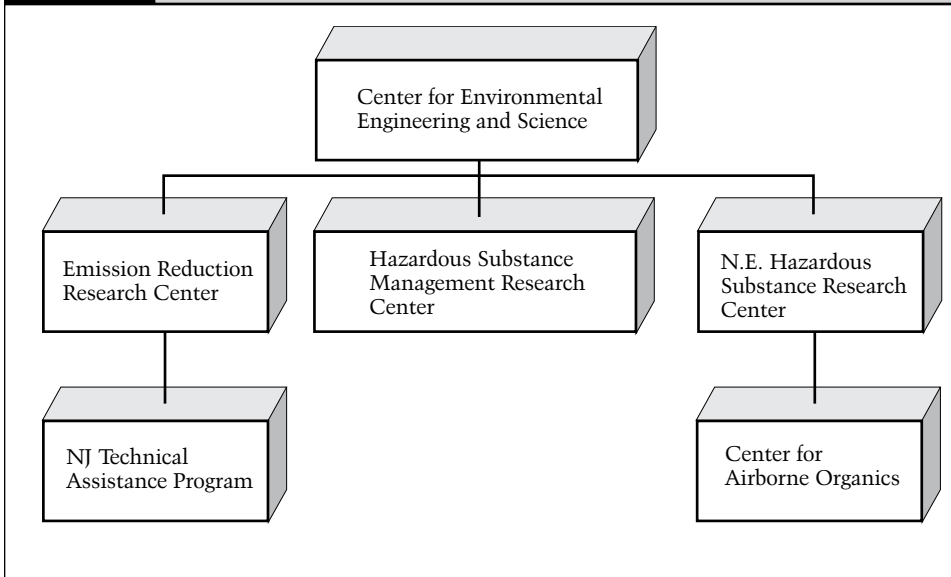
The I/UCR Center for Hazardous and Toxic Waste Management (also known as the Hazardous Substance Management Research Center) headquartered at NJIT is the largest and one of the most successful of the NSF I/UCRCs (see Figure 11-10). Started in 1984 with a critical mass of \$300,000 in IAB membership fees and ten members, it oversees five centers and programs within NJIT's Center for Environmental Engineering and Science with a total operating budget ranging from \$6 to 10 million.

Figure 11-9 Surviving as a contract research center.

The Center for Electrochemical Systems and Hydrogen Research (CESHR) at Texas A&M University has been through major organizational changes over the course of its life. Initially funded in 1983 as a hydrogen research center, CESHR fell victim to the oil glut; there was little interest among energy companies in funding research in alternative energy sources. Membership peaked at nine companies, and had fallen to two by 1987.

At about this time, the university associate provost for research reviewed the center and research program. He decided that the quality of the research and of the faculty were such that it was worth investing. A

new center director was hired, the university contributed \$1 million, and the modus operandi was shifted from an NSF-type consortium to a contract research operation. CESHR retained two members who paid \$20,000 per year for basic research. Federal grants, including a share of the \$2.5 million line item for hydrogen research in the federal budget and contract research projects for industry are the primary funding. With an operating budget of close to \$2 M in fiscal year 1989, CESHR was a highly successful contract research organization. Because results of individual research projects are owned by specific sponsors, CESHR ceased as an NSF I/UCRC.

Figure 11-10 Organizational chart—Center for Environmental Engineering and Science.

The Hazardous Substance Management Research Center (HSMRC) has a threefold mission of research, service, and technology transfer. Through its industry-university collaborative research, HSMRC advances the state-of-the-art in engineering management of hazardous waste. The work of the Center expands present knowledge and application of effective, environmentally acceptable, and economically feasible hazardous waste treatment and remediation technologies. The Center currently has 15 industrial sponsors and an annual budget of almost \$4.4 million. HSMRC also has two international research tie programs—the ReCoRD Center at the University of Lyon, France, and the QUESTOR Center at the Queen's University, Belfast, Northern Ireland.

The Emission Reduction Research Center (ERRC) is a National Science Foundation I/UCRC dedicated to research in pollution prevention in all environmental media, but with a particular concern to air emission reduction. ERRC, launched in 1994, is organized around clusters of companies in specific manufacturing areas. Industrial membership is currently seven members. The 1996-97 research budget is \$415,000.

Northeast Hazardous Substance Research Center (NHSRC). Recognizing the fact that current scientific knowledge and existing science-based technologies are inadequate to fully

address the identification, remediation, and management of hazardous substances, the federal Superfund Amendments and Reauthorization Act (SARA) authorized EPA to establish five university-based research centers. Two adjoining federal regions are served by each center. New Jersey Institute of Technology, in a consortium with Massachusetts Institute of Technology and Tufts University, was awarded the center to serve Federal Regions 1 and 2. This center was established in February 1989 to conduct research and training related to manufacture, use, transportation, disposal and management of hazardous substances. The center receives baseline funding of \$1 million per year from EPA. Supplemental funding of approximately \$1.5 million is provided from EPA, U.S. Department of Energy (DOE), and DOD in support of specific targeted research projects and four major new initiatives.

Center for Airborne Organics. The EPA has established a Center of Excellence for Exploratory Environmental Research in which the problem of deteriorating ambient air quality, particularly in our urban areas, is coming under significant research scrutiny in order to establish the scientific basis for corrective actions. NJIT has joined with Massachusetts Institute of Technology (MIT) and California Institute of Technology to form the Center, which became operational July 1992, and focuses its research on the transformation, transport, and control of airborne organic compounds. The Center operates on a budget of \$ 1 million annually shared among the three consortium universities.

New Jersey Technical Assistance Program (NJTAP) for Industrial Pollution Prevention has gained visibility and credibility with industry as an extension service that provides environmental audits; functions as an information clearing-house for literature and videotapes related to pollution prevention; delivers education and training; and adopts, develops, or aids in the development of novel pollution prevention technologies. The New Jersey Department of Environmental Protection (NJDEP) and EPA provide major funding for this program. Current funding levels are \$400,000 per year; NJDEP support has just been renewed through 2001.

It would have been impossible for HSMRC to absorb all of these missions. Instead an umbrella institute was created and new centers added. The CEES Director, Dr. Richard Magee, reports to the office of the Provost and has a point person to manage each center. Here is a collection of centers with clear overarching goals. They adapt and respond to new events by practicing "planful opportun-

ism." This collection of centers is subject to the same challenges of top-out that any I/UCRC faces. They may, however, be even more intense and complex.

However, it's worth remembering that while there are many organizational fixes for the challenges presented by center growth, some conflicts may be so great that they require choosing between one's center and an alternative opportunity. Every good strategy has a downside. Know what it is; moderate and monitor it. See Appendix 11-3.

SUMMARY

Many university-based centers, institutes, and labs provide services to industry underwritten by a single well-endowed federal or state sponsor for an extended or open-ended period of time. Such organizations typically do not need to develop a strategy for growth. They can achieve a critical mass overnight and devote themselves almost exclusively to performing research. Unfortunately, the long-term survival of these organizations often has more to do with satisfying their major governmental benefactor than their supposed customer base.

In contrast, cooperative research centers have much more in common with small entrepreneurial start-up companies. Survival, even over the short term, can never be taken for granted and must be the focus of considerable organizational energy. Ultimately, long-term survival depends upon the interplay of several factors: ability to develop and maintain a highly relevant and responsive research program, awareness of opportunities and needs they can meet in their environment, and selection and implementation of a winning growth strategy. While we have focused on growth here, the reader needs to remember any growth strategy is only as good as the research planning and environmental reconnaissance which supports it.

Various growth strategies appear to make sense for centers at different stages in their life-cycle. A strategy of expansion by volume appears to be the most straightforward and simple. It can be used throughout a center's life cycle. This strategy has the added benefit of building on a center's core competency and typically does not require substantial organizational redesign.

While geographic dispersion through partnership agreements can be used at start-up, this strategy has also become popular for mature centers, particularly those with static growth for core services. However, development of successful formal, ongoing partnerships

take a great deal of time and attention to detail. Choosing the wrong institutional or administrative partner can divert energies and result in center failure. Long-term success requires a willingness to re-engineer the center structure and a commitment to open and active communication between participating institutions.

Finally, vertical integration, particularly the provision of new but related research services, offers the potential for significant growth but requires the greatest commitment and can unbalance or dilute a center's core competence. It probably only makes sense for mature and stable centers. Adding missions, services or using a format which is substantially different from the standard I/UCRC approach will almost inevitably require a center to re-engineer its organizational structure. A variety of structural accommodations which can compensate for the stress caused by these changes were discussed.

In the final analysis, Center Directors need to be wary of trying to enlarge their centers too fast or too far from their core competency, a goal Galbraith and Kazanjian (1986) refer to as "controlled diversity." Since centers succeed in getting other support in large part because of their membership base and their infrastructure, they are well advised to reinforce the core competencies that keep their consortium-based membership happy.

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APPENDIX 11-1**Subcontract Agreement**

This agreement constitutes a Subcontract between the Center for X as an organized research unit of Y university, and Z university, hereinafter referred to as Z.

The purpose of this Subcontract is to carry out the tasks described in the proposal submitted to X by Dr Smith, the principal investigator(s), and entitled, "Closure Integrity" which is made a part of this Agreement as Appendix A. Z agrees to carry out the tasks listed and provide monthly updates on the progress of the work and quarterly reports giving a full account of the progress. At the termination of the grant Z will provide X with a report of the completed investigations (no later than 60 days following termination of the grant). Z agrees to adhere to the publication, software copyright, and patent policy as described in Appendix B. It is understood that if it is necessary for X to divulge certain confidential information, such as chemical structure of compounds or the nature of a process, to Z for the conduct of research for the public good, this information shall be treated in confidence until such time as disclosure is made by X.

Performance under this agreement shall begin January 1, 1997, and shall not extend beyond the completion date of December 30, 1998, unless the period is further extended through mutual agreement in writing.

X shall reimburse Z for all direct costs incurred in the performance of the research as set forth in the Budget contained in Appendix A. It is understood that X will not reimburse Z for any administrative or indirect costs associated with the research. Within the total estimated cost of \$62,585, Z shall not shift more than ten percent of the funds from any category without written approval from X. X agrees to deposit by quarterly installments the total amount of the award with Mr. Jones, the financial official of Z during the designated period, with the initial payment made upon receipt of this signed Subcontract Agreement. Disbursement of said funds will be made by the financial official of Y. However, installments may be delayed by X due to lack of performance in accordance with this agreement and of the specified research schedule as noted in Appendix A.

Z agrees to retain and make available for possible X audit all books, records and other documents relative to this agreement for three years following completion or termination of the specific research programs or termination of this agreement, and to provide

X a final expenditure report within 90 days of the contract period. Any funds unexpended by the end of the contract shall be returned to X with the final expenditure report.

X, as an organized research unit of Y, shall not be liable for the actions of Z nor shall Z be liable for the actions of X. It is understood that Y, an agency of the State of _____, is limited in any claims that may be made against it for negligence up to \$100,000 as provided by the State Tort Claims Act.

Z agrees to comply with relevant federal and state executive orders, rules, regulations, and laws including OMB Circular A-21, and policies and bylaws of X as noted in Appendix B.

Should unforeseen developments take place that necessitate an interruption of the said project, this agreement may be renegotiated upon thirty (30) days written notice by either party.

Z shall not use the names or symbols of Y and/or X or of the investigators or any derivative thereof, in any advertising or promotional sales literature without the prior written consent of Y and/or X in each case.

Z shall have complete direction of the approved project and other activities associated with the efficient conduct of the study. The proposed research shall be conducted under the direct supervision of the Principal Investigator who will be accountable to Z.

In order to effectively conduct the proposed project, Z agrees to furnish such facilities and equipment as are required insofar as facilities of Z will permit.

No waiver, alteration or modification of these provisions shall be binding unless in writing.

Neither this agreement nor any right, remedy, obligation or liability arising hereunder or by reason hereof shall be assignable by Z without the prior written consent of X and/or Y.

This agreement is binding upon and shall inure to the benefit of the parties hereto, their representatives, successors and assigns. No failure or successive failures on the part of X, its successors or assigns, to enforce any covenant or agreement, and no waiver or successive waivers on its or their part of any condition of this agreement shall operate as a discharge of such covenant, agreement, or condition, or render the same invalid, or impair the right of X, its successors or assigns, to enforce the same in the event of any subsequent breach or breaches by Z, its successors or assigns.

APPENDIX 11-2**Memorandum of Understanding Between
My University and Your University**

This Memorandum of Understanding (MOU) is effective the ____ day of _____, by and among My University (hereinafter referred to as 'MY') and Your University (hereinafter referred to as 'YOUR'), to be known collectively hereinafter as 'INSTITUTIONS'.

WHEREAS, the parties to this Agreement intend to join together in a cooperative effort to support the Center for Partnership (hereinafter referred to as 'CAP') in its efforts to create concepts, methods, and tools for use in our area of science; to stimulate industrial innovation; and to provide INSTITUTIONS with strengthened educational and research capabilities in these fields.

WHEREAS, the activities of CAP are funded by (I) National Science Foundation (hereinafter referred to as 'NSF'), (ii) Industrial Members (hereinafter referred to as 'MEMBERS'), and (iii) other funds that may be received from time to time.

WHEREAS, INSTITUTIONS are desirous of formalizing certain agreements between them with respect to the subject matter contained herein.

NOW THEREFORE, for and in consideration of the mutual promises and covenants herein contained and intending to be legally bound, INSTITUTIONS hereto agree as follows:

1. Center Funding.

a. During the initial period of this joint center, each Institution will receive its own funds directly from NSF, will be responsible for recruiting its own MEMBERS, and will retain membership fees collected from its MEMBERS.

b. When NSF decides to make a single payment to one Institution for distribution between INSTITUTIONS, all membership fees will be deposited into a single account for distribution to INSTITUTIONS for core research selected by the Industrial Advisory Board (hereinafter referred to as IAB), as specified in the CAP Bylaws.

2. Center Governance.

a. By mutual agreement between parties, CAP will be governed by a common set of Bylaws (a copy of which is attached as Schedule A) and each party's Membership Agreement will have common terms and conditions. The CAP will have a common IAB, Academic Policy Committee, and Research Advisory Committee, with composition and duties as prescribed in the CAP Bylaws.

b. During the first five year funding period, and in accordance with the proposal submitted to NSF and the subsequent awards, the Center's Executive Director will be from MY. The Policy Advisory Board, with the concurrence of NSF, will determine whether, in the subsequent funding period, the Executive Directorship will remain at MY or rotate to YOUR. Site Directors are selected and appointed in accordance with the policies and procedures of each Institution, and as specified in the Bylaws.

3. Cross-Funding of Research. The transfer of funds between INSTITUTIONS for core projects selected by the IAB will be made without the assessment of the indirect costs normally associated with the issuance of a subcontract.

4. Ownership and Administration of Intellectual Property. Subject to the rights of MEMBERS contained in the Bylaws and Membership Agreement, all right, title, and interest in and to all Intellectual Property (hereinafter referred to as 'IP') shall be based on inventorship and shall be allocated as follows:

a. All IP invented by inventors solely at one Institution shall belong solely to that Institution.

b. All IP invented jointly by personnel of INSTITUTIONS will belong jointly to each Institution. In the event one Institution has a lead inventor or houses the laboratory of the Principal Investigator of a research project leading to the joint IP, that Institution shall administer the IP. In the event INSTITUTIONS have contributed equally to a joint IP, then the Site Directors and Deans shall determine who shall administer the IP. After identifying the Institution that will administer the joint IP, INSTITUTIONS shall negotiate in good faith an Inter-Institutional Intellectual Property Agreement, the form of which is attached as Schedule B, which agreement shall contain, *inter alia*, terms and conditions concerning the sharing of royalties and costs associated with the joint IP. The Institution administrating any IP shall keep the other

Institution advised as to the activities in administering the IP including any progress on commercialization, patent prosecution, or copyright protection. AU such information received by either Institution shall be deemed confidential.

c. Each INSTITUTION shall be responsible for the identification and evaluation of its sole IP and for informing MEMBERS regarding IP as outlined in the Bylaws and Membership Agreement. If MEMBERS and the inventing INSTITUTIONS agree that patent protection should be sought and if MEMBERS are interested in securing such protection, the process will follow the, outlined in the Membership Agreement. If MEMBERS are not interested in procuring protection for inventions, the inventing INSTITUTIONS may determine on their own whether protection will be sought, and that INSTITUTIONS may dispose of the IP as it sees fit.

d. INSTITUTIONS shall jointly review any joint IP, evaluate its commercial potential and inform MEMBERS regarding the joint IP as outlined in the Bylaws and Membership Agreement. If MEMBERS and INSTITUTIONS agree that patent protection should be sought and if MEMBERS are interested in securing such protection, the process will follow that outlined in the Membership Agreement. If MEMBERS are not interested in procuring protection for inventions, INSTITUTIONS will manage the joint IP according to the terms of the Inter-Institutional Agreement.

5. License to Use Intellectual Property for Internal Use. With respect to IP belonging solely to YOUR or MY, each party agrees to and does hereby grant to the other, subject to the terms of this agreement, a nonexclusive, nontransferable, irrevocable, royalty free license for educational and research purposes only (without the right to sublicense). This license shall include the right to utilize any information and materials published by CAP. Both YOUR and MY acknowledge that a separate license agreement may be required by the Licensor in order to convey the rights granted by this paragraph.

6. Publication, Sale or Use of Research Results on Jointly Owned Intellectual Property.

a. Subject to CAP Membership Agreements, each Institution shall have the right to publish research results on jointly owned IP. It is provided, however, that the Institution desiring to publish such research results shall submit a draft of any such proposed

publication to the other Institution at least twenty (20) days prior to the submission of the research results for publication. Either Institution shall have the right to delay any publication for a period of not more than sixty (60) days for the purposes of obtaining patent protection by giving the other Institution notice before the end of the twenty (20) day notice period provided hereinabove. For the purposes of this MOU, cataloging and placing reports of research results in the library of any Institution shall be deemed to be a "publication."

7. Miscellaneous Provisions.

a. This MOU may be revised by mutual agreement between INSTITUTIONS at any time.

b. In the event that any of the terms, provisions, or covenants contained in this MOU are held to be partially or wholly invalid or unenforceable for any reason whatsoever, such holding shall not affect, alter, modify, or impair in any manner whatsoever any of the other terms, provisions, or covenants not held to be partially or wholly invalid or unenforceable.

c. This Agreement shall be subject to the CAP Bylaws and Membership Agreement, and in any conflict, the Bylaws and Member Agreement shall have precedence.

10. Period of Performance. The period of performance of this Agreement will be concurrent with the CAP contract with NSF.

IN WITNESS WHEREOF, INSTITUTIONS hereto have caused this MOU to be duly executed by their duly authorized officers as of the day and year set forth next to each signature.

MY UNIVERSITY

YOUR UNIVERSITY

APPENDIX 11-3**Overview—Pros and Cons of Various Organizationally Compatible Strategies**

Strategy	Pros	Cons
Increase Membership Fee	<p>A simple strategy for increasing financial resources.</p> <p>Doesn't require extensive investment of time on part of Center Director.</p> <p>May result in predictable percentage increase in annual revenues.</p>	<p>May be hard to sell when corporate budgets are tight.</p> <p>Requires near unanimous assent by center members to be profitable.</p> <p>Getting approval of new agreement may be difficult.</p> <p>Requires a well-prepared proposal, lots of support, and good timing.</p>
Research Enhancements	<p>Proven strategy; constitutes 11 percent of I/UCRC budget.</p> <p>Convenient for members; follow-on research done under center bylaws.</p>	<p>Requires well-prepared proposal, lots of support, and good timing.</p> <p>May pull center in a direction which is too applied.</p>
Intensive Recruiting	<p>An efficient use of recruiting time.</p> <p>Recharge faculty and member involvement</p> <p>Familiar; same strategy as used when building center.</p>	<p>Must catalog and document center successes to use as part of sales presentation.</p> <p>Major time commitment.</p>

Strategy	Pros	Cons
Multiple-Level Fee Structure	<p>Helps attract small businesses.</p> <p>May add to center's technological mix.</p> <p>Helps reinforce supplier-manufacturer ties.</p> <p>May coincide with state initiatives.</p>	<p>Adds complexity to recruiting, bookkeeping, etc.</p> <p>If goals differ, may cause conflict in consortia.</p> <p>May be difficult to reach a compromise on privileges offered to associate members.</p> <p>Rarely results in significant membership increase.</p> <p>Current members may opt for lower fee.</p>
Federal and Military Members	<p>Capitalizes on dual-use orientation.</p> <p>Proven strategy: ten percent of current members.</p> <p>Capitalize on MIPR mechanism of funding.</p>	<p>Federal or military goals and time-frames may conflict with industrial.</p> <p>Some agencies may want to recruit your members.</p>
Non-Profits and Associations	<p>May be prominent in the field.</p>	<p>Has not paid off for most centers.</p> <p>Rights accorded association members may be difficult to resolve.</p> <p>Some non-profits may want to recruit your members.</p>

Strategy	Pros	Cons
Traditional Grants	<p>Proven strategy: 20 percent of I/UCRC support.</p> <p>Centers have competitive advantages.</p>	<p>May cause internal conflicts between department and center.</p> <p>Must be congruent with goals.</p>
Multi-University Partnerships	<p>Proven strategy; almost half of all I/UCRCs.</p> <p>Partner university can diversify technology and industrial network.</p> <p>Can add geographic balance.</p> <p>NSF will assist.</p> <p>Provides “one-stop shopping” for members.</p> <p>Can use informal partnerships like TIEs to pilot.</p>	<p>University administrators resist sharing resources.</p> <p>Takes a lot of work and “hand-holding” to create new sites.</p> <p>Requires more administrative effort for coordination.</p>
Educational Services	<p>Broadens the center’s mission.</p> <p>Adds “perk” some members may value.</p> <p>Can be personally rewarding.</p> <p>NSF may support.</p>	<p>Rarely pays large financial dividends.</p> <p>May strain center’s organizational ability.</p> <p>Divergent populations (e.g., pre-college) increase strain.</p>

Strategy	Pros	Cons
Contract Research	Can add support for faculty.	May pull center in a direction which is too applied. Need to develop mechanism to keep separate from core. May weaken consor-tial ties that empha-size shared research.
Large Institutional Awards	Proven strategy; constitutes about 30 percent of I/UCRC budget. Centers have competitive advantages.	Single dominant spon-sor may divert center from industrial mis-sion. May require major organizational restructuring.