# 5.1 Establishing an Industrial Affiliates Program

A critical initiation activity in any center is establishing buy-in for the vision and putting in place the infrastructure that is required for effective industrial collaboration and innovation programs, including agreements with stakeholders, marketing programs, and systems for tracking interactions with industry and innovation partners. The Center Director and senior leadership of the center typically form the vision and strategic plan for industrial interaction and innovation during the center's proposal development process. The infrastructure required to affect this vision and strategic plan must be developed and honed with post-NSF self-sufficiency in mind.

In the initial months of new ERC formation, it is important to work with the university and its technology transfer office to establish internal support and work out an ERC membership agreement for the program. NSF requires each ERC to develop its own generic membership agreement, governing the participation of industrial and practitioner members and specifying the forms of industrial cash and in-kind contributions that constitute membership in the center, as discussed in Section 5.1.2. It is important to remember that this must be an ERC-wide agreement that includes an ERC-wide IP policy, encompassing the lead and partner institutions.

In ERCs where university/industry research centers may already exist, it is essential to examine and compare the existing membership structures, fees, and terms and conditions and involve all key personnel at the universities from the start in drafting the new ERC agreement. Support for the ERC is generally high immediately after the awarding of the cooperative agreement, and the climate for negotiating long-term university support is strong. Be mindful that some universities may have Industry/University Cooperative Research Centers, where the agreements are different from ERC agreements and some university officials may not be aware that they are different.

Experience shows that while many ERCs may have one or two technical disciplines and therefore departments that dominate the ERC researcher and student populations, ERCs are by their nature cross-disciplinary and therefore will involve talent and infrastructure from multiple departments, and sometimes multiple colleges—although Colleges of Engineering should and do dominate, as one would expect. ERC Directors must report to the Dean of Engineering.

## 5.1.1 Foundational Agreements to Establish Industry Collaboration and Innovation

Establishment of an ERC requires certain foundational agreements to be expeditiously put in place in order to set the stage for success. It is critical that the ERC and host university complete these agreements as early as possible in the ERC’s first 12 months in order to establish a sound working protocol with all ERC stakeholders.

### 5.1.1.1 ERC Agreement with Host University Regarding Overhead and IP Returns

One key element of structure is the development of an agreement in the early initiation of the ERC regarding overhead and technology licensing returns to the ERC cost center vs. other university cost centers such as the disciplinary departments. Clearly, overhead return discussions can become problematic if faculty are conflicted between submitting proposals (industry or federal agency funded) through their home department  vs. the ERC.

Similarly, many university intellectual property policies provide technology licensing royalty, fee, and equity liquidation returns to various units (university research office, college, department, inventors) and sometimes include “centers” or “research units” if the invention was spawned in a separate unit. ERCs should get specific, early commitments on what overhead and royalty returns will flow to the center to avoid confusion and hard feelings downstream. If the center is not included initially in IP licensing returns, the director can approach the university administration or technology transfer office and negotiate a portion of future royalty returns to be earmarked for the center. Because there is no “money on the table” during these negotiations, it may be possible to secure a future revenue stream before the center even begins its research. Taking a long-term view toward self-sufficiency for the center, it is a good idea to participate in royalty and equity liquidation returns and set those policies in place early.

All centers work with their university intellectual property officers to comply with university standards on such

matters. A good working relationship with the university IP administrators is important in developing a successful partnership with companies. Since centers span more than one university, clear agreement among the administrations of all the academic partners is essential. Procedures for notifying industrial partners of the existence of center-developed IP should be clarified between the center and the universities' intellectual property officers. In all cases, IP agreements should accord with regular NSF guidelines, as set forth in the effective NSF Grant Policy Manual.

### 5.1.1.2 ERC Host University Agreement with Domestic Partnering Universities

The ERC host university should work diligently in the initial year of the ERC to assure that agreements with partnering universities involving intellectual property management rights and responsibilities, reporting responsibilities, industrial partner benefits, etc., are consummated at the start of the Center's life. Of specific concern is to assure that the research review and intellectual property rights provided to industrial partners of the ERC through their industrial membership agreements accrue to them regardless of which partnering university faculty are inventors. This should include clear and unambiguous agreement as to industrial partner benefits from core research funded by membership fees, the ERC award, university cost sharing, and other funds provided to the ERC without restriction regarding use, as opposed to sponsored project research supported by industry or other sources. Industry membership agreements typically provide rights to core research of the ERC, with no mention as to the origin of inventions from that core research. Rights granted to industry partners must be consistent with inter-university agreements and ERCs must assure that this is codified in Inter-institutional Agreements or subcontracts at the time of engaging initial industry partners.

*CASE STUDY: The issue of "royalty distribution" back to the ERC instead of the home department of the inventing investigator(s), for inventions arising from ERC research, is a sensitive one. University policies vary greatly, and the question of what is fair is valid. One example is the long-graduated Data Storage Systems Center (DSSC), at Carnegie Mellon University (CMU), which was an ERC from 1990 to 2001. This now self-supporting center produced some key technologies in data recording that continue to have an impact on the industry today. CMU's Intellectual Property policy is one of the most liberal in the country, in that it gives 50% of all royalties to the inventor(s) and 25% to the research unit (in this case, the DSSC), retaining only 25% for the university, which actually owns the patents. Most universities retain considerably more. One factor in CMU's decision to allocate the research unit's proportion of the royalties to the DSSC is that DSSC holds a considerable portfolio of patents, and the Center pays the cost of each of those patent applications. Royalty returns to both the Center and to individual faculty and even students have, at times, been substantial and have contributed significantly to the DSSC's success in maintaining self-sufficiency. Based on this history and that of other ERCs, the NSF ERC Program management believes that ERCs should negotiate with the host and partner universities a portion of licensing returns to the ERC (royalty, equity liquidation, and other forms of payment such as fees and litigation returns) for ERC-generated technology, as a unit of the university's research enterprise. The rationale for this is that it is the cross-disciplinary research program and the ERC's testbed culture that have generated the technology, not the investigator's laboratory alone. It is true that university administrations will likely be resistant to changing their royalty return policies; negotiations after the award is made might actually be easier than at the proposal stage. Although NSF recognizes that the high levels of return that DSSC enjoys are extremely rare (even anomalous), there are several other centers with this type of royalty distribution allocation, although at lower percentages. DSSC provides an example of the impact that this issue can have on ERC self-sufficiency.*

### 5.1.1.3 ERC Agreement with Foreign University Partners

One area that merits further discussion is the formulation and execution of international agreements with foreign university partners. This originally was a required component of a Gen-3 ERC, but because of the complexities outlined below, beginning in FY 2013 a Gen-3 ERC may enter into a focused partnership with a foreign university governed by a formal agreement with mutually protective IP policies, or faculty-to faculty collaborations. In either case, the partnership/collaboration must allow for ERC students to spend at least 30 days working in the laboratory of the foreign partner/collaborator.

The establishment of the ERC/foreign university partnership agreement can involve a steep learning curve, concentrated on the complexities of international law and the vast differences in scientific culture and legal environments, especially in intellectual property ownership and business law specific to the partnering university's home nation. The "harmonization" of the final international agreement can take a great deal of time and expense that an ERC has to bear. These agreements need to engage the highest levels of the administration on both sides

(university presidents, university system officials) from a policy and legal standpoint. The following is a case history of the IP issues involved in an exemplar ERC/foreign university partnership.

*CASE STUDY: A partnership was formed between the Revolutionizing Metallic Biomaterials ERC (RMB) based at North Carolina Agricultural and Technical State University and the University of Hannover Medical School in Hannover Germany. North Carolina A&T, as the host university on behalf of the ERC, negotiated a fixed fee with a local law firm with international business and IP law expertise to interpret German law and to draft a harmonized agreement. The German Inventors law differs from the Bayh-Dole Act in that, rather than assigning intellectual property rights to the University, German scientists and engineers retain rights to their inventions. German Law allows for a period of time in which a German employer (University) may secure rights to an invention in return for fair compensation to the inventor at the time of transfer of rights. If this option is not exercised in a timely manner, IP rights remain with the inventor. This arrangement tends to limit the nature of the global interaction between Hanover and the ERC to student and technical exchanges, as the ERC cannot ensure that IP obligations under Bayh-Dole will be met in cases of joint inventorship between an ERC investigator and a German investigator. It may be possible to address this concern. Opportunities for the ERC to participate in the option discussions between the University and the German inventor are being explored.*

As exchanges occur and joint IP becomes an issue, the agreement needs to include some mechanism to capture that IP under mutually protective terms. Additionally, ITAR and export control restrictions, especially with the development of new materials, need to be addressed in terms of international agreements. This could impact the exchange of information, materials, samples, and prototypes.

Faculty-to-faculty collaborations would operate under less formal terms, as is traditional in academic research. However, the ERC still needs to be mindful to protect ERC-funded IP.

### 5.1.1.4 ERC Agreement with ERC Researchers

One area that is easy to overlook is clarifying and codifying the relationship between the ERC and its researchers at the different partner universities. While this may seem trivial, as university faculty and students are typically accustomed to working in various research groups and with myriad affiliations, the ERC is different in that it has specific requirements of its researchers and also provides specific benefits (e.g., intellectual property rights) to industry partners. The ERC has an opportunity early in its existence to establish a clear understanding with researchers funded by the ERC as to what is expected of them and what they can expect of the ERC. While this agreement can be as complex as the ERC desires, simplicity usually serves all parties better. The agreement may be as simple as a letter of understanding between the ERC and relevant researchers outlining what is expected of them (e.g., participation in industry meetings, collaborating with industry partners on a reasonable and mutually beneficial basis, contributing to ERC reports to NSF or industry partners). Additionally, this communication should also inform the researchers of industry partner intellectual property rights granted through the ERC Industry Membership Agreement. Most universities outline researcher rights and returns from IP through a university intellectual property policy, and the ERC agreement may provide for rights that impact researcher returns from their technology (e.g., their return of IP royalties may be impacted if the ERC provides partners with a non-exclusive royalty-free right to use of inventions from ERC researchers).

### 5.1.1.5 ERC Agreement with Student Researchers

After knowledge generation, one of the most important outputs of the ERC is the students it graduates. But the ERC graduates and post docs are more than just statistical outcomes of NSF’s investment. They are also stakeholders in the ERC enterprise and as such they have a voice (through the student leadership council) and rights that need to be protected. Given the Gen-3 ERC’s drive to facilitate the translation of technology to the commercial sector, situations where an ERC participant has significant financial interests in the collaborating firm or other entities affected by the proposed research are beginning to emerge. These constitute conflicts of interest (COI) that must be managed by the participant's home university. An important aspect of managing the conflicts is for the home university to put in place policies that protect students, should their dissertation work potentially affect the value of a company in which the faculty advisor has an ownership or managerial interest.

*CASE STUDY: Virginia Tech has various policies and procedures on managing conflicts of interest for the protection of students. For example, an informational page on protection of students and trainees in projects sponsored by faculty-owned businesses (Policy 13010, which can be found at http://www.policies.vt.edu/13010.pdf*

*) contains the statement "This policy provides the basic framework for assessing potential conflicts of interest or commitment and outlines related procedures for the management and monitoring of external activities in a manner that will both promote and safeguard the interests and reputation of Virginia Tech, its faculty and students, and their research." Another example is Protecting the Interests of Students and Trainees (which can be found at https://www.research.vt.edu/conflict-of-interest/students-and-trainees ). This document begins with the statement "The impact of a perceived or actual conflict of interest or commitment of faculty members on their students (including post-doctoral fellows and other trainees) is of special concern to the university. In particular, the university is committed to maintaining the content and quality of the educational experience for students whose research is sponsored by a for-profit business and whose faculty advisors have a financial interest or a management role in that business. The concern is even greater if the dissertation work could potentially affect the value of a company in which the faculty member has an ownership or managerial interest."*

### 5.1.1.6 ERC Agreement with Industry Members

Along the same lines, ERCs under the direction of the ERC Director, ILO, and university technology transfer and contract offices should put significant effort into finalizing industrial partner agreements very early in the life of the ERC, ideally within the first few months of award. This is critical as ERCs typically start with a cadre of industry partners that have participated in the pre-award activities and this base can grow quickly with proper recruitment. Changing an industrial partner agreement becomes much more difficult, and dangerous in terms of losing current industry partners, the further downstream agreements are put in place or modified. This topic is covered in detail in Section 5.1.2.

## 5.1.2 Establishing the Membership Agreement

Within the first few months after the start of the ERC's award from NSF, each ERC develops a standard membership agreement that governs members' participation and sets out the forms of cash and in-kind contributions that constitute membership. It is critical that establishment of this membership agreement be completed as early as possible in the life of the ERC—certainly within the first year of NSF contract award—since establishing an agreement that is acceptable to the ERC, partnering universities, industrial partners, and innovation partners early will capture the partners' excitement as the ERC is established, resulting in establishment of the initial industrial partner consortium. In addition, if the ERC Program first year site visit team finds no firms or only a few that have signed on to be members of the center because the agreement took too long to finalize, that will not bode well for their judgments regarding management of the ERC.

An ERC should not to try to develop individual contractual arrangements for each company in lieu of a membership-defined program of industrial collaboration that encompasses all members. It's critical that the membership agreement be well established, as there will be little to no room for modification once the industrial membership base is built. Any downstream modifications to the membership agreement that potentially impact current member rights would then need to be renegotiated with all affected members—typically not a viable situation and one to be avoided at almost any cost.

Organizations that can be considered as ERC members include private firms as well as local and Federal government agencies that have joined as members, agreeing to financially support the ERC through the payment of fees and participation in its research and education programs, per NSF ERC policy. Organizations contributing staff to carry out research and educational projects in the center, such as other universities, government agencies or laboratories, institutes, and hospitals, should not be counted as members. In addition to paying fees in cash, member companies/practitioner organizations may augment their support to the center through in-kind contributions as part of the membership fee or in addition to the fee structure. Finally, additional support for directed sponsored projects or contractual arrangements is a way to speed the translation of ERC-developed technology into use.

Firms that are not members but provide directed project support often are classified as "affiliates" and firms and others that provide equipment and other donations are classified as "contributing donors." Additionally, entities that contribute primarily to the innovation mission of the ERC are considered Innovation Partners, as discussed in Section 5.3.3.

Guidelines for ERC industrial membership agreements, including example agreements, are available to registered users of the ERC Association website at www.erc-assoc.org/ilo-forum.

The overall intent of the Industrial Membership Agreement is to establish a contractual relationship that is:

1. mutually beneficial and equitable to both parties of the agreement;
2. scalable to a large ERC industrial membership;
3. applicable to companies of all sizes (small and large); and
4. clearly outlines the rights and obligations, if any, of company subsidiaries, sister, or parent organizations.

### 5.1.2.1 Necessary Elements of the Industrial Membership Agreement

In establishing an industrial membership agreement, the ERC must balance the need to keep the agreement as simple and straightforward as possible so as to make a single agreement palatable to the many companies the ERC will engage as industry partners vs. the need to assure that the document equitably addresses all of the critical elements of such an agreement to avoid downstream lack of clarity on terms and conditions (e.g., IP management and publication rights). In order to assist in this important activity, NSF has established a Gen-3 Membership Agreement Checklist to guide new ERCs in necessary elements of a membership agreement. The NSF Gen-3 Membership Agreement Checklist requires that ERCs consider the following in establishing industrial membership agreements[1]. Specifically, does the agreement:

1. Function as an ERC-wide membership agreement, encompassing the lead and core partner universities
2. Define which institutions are considered lead and core partner universities in the ERC and their responsibilities to the ERC
3. Define the types of organization that are allowed to join the Industrial Advisory Board (IAB) and specify the following IAB responsibilities to the ERC:
    1. meets a minimum of twice a year;
    2. develops an annual Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis;
    3. participates in NSF annual reviews of ERC performance and plans and present the IAB SWOT; and
    4. provides input on strategic research and education plan, ongoing project performance, and proposed project plans.

1. Define:
    1. IAB Membership categories;
    2. IAB Membership fee structure (perhaps include a table using the format of Table 5.1 below to tabulate membership fees for each member category);
    3. what it takes to maintain membership in good standing;
    4. benefits received for each level of membership;
    5. terms of membership and termination;
    6. conditions for acceptance of “in-kind” in addition to cash. (This is permitted at the Center Director’s discretion, but it must be at a discount rate of 30% to 50% of retail value. Furthermore, the aggregate amount of dues collected as discounted in-kind payments should not exceed 25% of the cash dues collected);
    7. core research and the sources of funding for the core research; and
    8. non-core research and the sources of funding for associated and sponsored projects;

Table 5.1: Sample IAB Membership Structure Matrix

| Rights and Benefits | Member Category #1 | Member Category #2 | Member Category #N |
|---|---|---|---|
| Right #1 | | | |
| Right #2 | | | |
| Benefit #n | | | |

1. Define how information that is considered to be confidential will be handled among the ERC and IAB parties
2. Define how publications with potential IP implications will be handled, vis-a-vis protecting the IP rights of IAB members
3. Define the following with respect to IP:
    1. require that joint IP agreements be in place across all universities;
    2. require that joint IP agreements be in place between ERC and industry researchers;
    3. when and how one determines that research developments are to be classified as intellectual property and who owns the IP;
    4. when must a firm be a member in good standing in order to qualify for the first option to license the technology;
    5. maximum time period that the members of the IAB are granted to review and claim the first option to license ERC-generated technology (if this is too short it can appear to industry that the faculty want to reserve technology for their own spin-out firms, or if it is too long it can retard the advancement of new technology);
    6. whether non-exclusive royalty free (NERF) licenses are granted for research only;
    7. whether exclusive licenses take precedence over NERFs;
    8. the conditions under which exclusive royalty bearing licenses are granted;
    9. IP terms for sponsored projects; and
    10. a process for qualifying to apply for translational research funding from NSF that is consistent with the flow diagram in Figure 5-6 of Section 5.3.2.1 and the Program Terms and Conditions (PTC) outlined in Section 4.e.iv of the ERC Cooperative Agreement (See Attachment 5-B).

### 5.1.2.2 Structure of the Industrial Membership Agreement

Attachment 5-C provides a sample membership agreement that can be used to inform new ERCs of the critical elements of an ERC Industrial Membership Agreement and sample language that has been successful in such ERC agreements over the years. It should be noted that this sample agreement is not meant to be prescriptive, but instead to act as a guide to ERCs as they establish their Industrial Membership Agreement specific to their university and industry needs.

The following is offered as general guidance as related to the elements of the Sample ERC Agreement provided in Attachment 5-C:

- General Obligations of the ERC Host University, Partnering Universities, and Industry Members—The university and industry partners must manage expectations and clarify what each entity can expect from their partners and, as importantly, what is not included as part of the partnership. This is especially critical early in the life of the ERC, as industry champions are engaged but provide a minority of the overall ERC funding.
- Relationship of the University Partners and Industry Members' Rights—This element is important in defining the extent to which the rights and obligations of the industry members extend across the ERC's university partners. It is standard practice that industry members enjoy consistent rights provided through their ERC Industrial Member Agreement (e.g., Intellectual Property) across all partnering universities; but this is an issue for the university partners to address, codify in Inter-institutional Agreements (IIAs), and clearly transmit to industry members.
- Expectations and Obligations of Industry Members—Industry members must understand that they are expected to play a critical intellectual role in the ERC in addition to financially supporting the center. Specifically, industry members are expected to support the research, education, diversity, technology transfer, and innovation goals of the ERC, including: demonstrating the scientific and technological feasibility of innovative methodologies and systems; assisting in the transfer of research discoveries and observations from the university to industry and vice versa; and developing an interdisciplinary education program that prepares diverse cadres of domestic ERC graduates for effective industrial practice with U.S. firms and provides opportunity for enhancing creativity and innovation. At a minimum, the industry members should commit to: meeting at least twice a year; developing an annual SWOT analysis; participating in NSF annual reviews of ERC performance and plans; and providing input on the ERC's strategic plan, ongoing project performance, and proposed project plans. Some ERCs have chosen to

codify these requirements in the Industry Member Agreement while others have chosen to include them in ERC Bylaws that are then included by reference in the Industry Membership Agreement. Either is acceptable, but what is expected of industry members should be clearly explained in a broadly applicable document. This approach allows more flexibility in defining the role of the IAB without having to renegotiate the agreement with each firm.

- Entities that are Eligible to Serve as Industry Members—Various business entities and government agencies may become industry members. Some ERCs have chosen to include investment groups (e.g., venture capital entities) that technically meet this definition; but the ERC must be cognizant of the challenges and opportunities presented, and may instead choose to include these groups as innovation partners or other partners. The details and implications are discussed in Section 5.3.3.
- Use of Resources—It's important to clarify the flexibility and bounds that the ERC has in allocation of resources, including industry member fees, so as to establish a support base for the entire scope of the ERC program (e.g.. research, education, outreach, technology commercialization, and innovation), as opposed to the restricted scope encompassed by a sponsored project..
- Term and Termination—Different ERC's choose to provide an initial term for the Industry Member Agreement of one to five years to suit the needs of the types of firms in the ERC's value chain. Obviously longer terms, with appropriate termination conditions as discussed here, are beneficial for planning purposes, but may not be palatable to all industry members, so some flexibility may be required. The Sample Agreement provided in Attachment 5-C provides for an automatic renewal (aka an "Evergreen Clause") for an annual term. This clause is desirable for the ERC to include regardless of the term of the agreement, as the agreement will then roll over to subsequent terms without further management or legal review triggered—simplifying renewal for both the university and the industry member. A mutually acceptable termination clause through written notice is considered standard so long as the notice period is sufficient to not disrupt research and education programs and student progress.
- Applicable Law—Most public universities must operate under the laws of their state and little flexibility may be available here, other than for the agreement to remain silent on this issue if acceptable to the university and the industry member.
- Publication Rights—Industry members must understand that publication of ERC created research results is of fundamental importance to universities, faculty, and students. At the same time, industry members should expect that they have the opportunity to harvest commercial value from ERC scientific advances as outlined in their Industry Membership Agreement. As such, clarity on the process, conditions, and timing of publications with regard to IP protection and review of data is essential in the agreement. The university and industry must be comfortable with these terms and the process that will be followed. One such version is outlined in the Sample Agreement of Attachment 5-C.
- Confidentiality—This clause captures the intent of both parties to maintain the confidentiality of information marked as such that may be passed between the parties. This can be through individual project collaborations as well as during Industrial Advisory Board meetings. The ERC should consider specific Confidentiality Agreements for such information transfer as appropriate, but this statement is important to include for general information that might be exchanged in order to foster more open communications between the parties. This statement should be reviewed carefully by the university legal counsel.
- Other Rights and Obligations—As outlined in the Sample Agreement, other rights and obligations that are usually non-contentious but important might include equal opportunity and non-discrimination, use of names, the legal relationship between the parties, liability, and representation. These and others that might be required by the universities should all be clarified in the agreement.
- Intellectual Property Rights and Management—IP management is typically the most difficult portion of the agreement on which to agree, and is also one area with the least flexibility once the agreement is executed with the first industry members. There is very little to no room for downstream modification to IP terms as the ERC builds the industry member base, as any downstream modifications would typically affect rights of existing industry members, which would then require renegotiation and execution of the agreement or an addendum capturing the changes. This portion of the agreement is typically the most difficult to craft and, as such, is dealt with in detail in Section 5.3.2.
- Membership Structure, Fees, and Benefits—The membership structure can be simple or relatively complex, with tiers for both membership category and company size, and so is dealt with in detail in Section 5.1.2.3.

### 5.1.2.3 Membership Tiers and Fees

Across all ERCs, annual industry membership fees have ranged from $1,000 to $250,000, usually encompassing a tiered membership structure that includes two or three membership categories with corresponding fees and benefits of membership. While various benefits as discussed below can accrue to the highest membership tier,

lower level members may not enjoy benefits such as favorable access to IP.

Many centers allow larger firms to affiliate either in limited ways (by research area or by specific contractual projects) or in a broader way (full membership with maximal rights), with fees usually ranging from $10,000 to $50,000

Company size can also be a differentiator in fee structure. ERCs often will provide a discount on the membership fee for mid-size or small companies, in some cases even for “start-up companies”, to encourage their full participation and spur technology transfer and innovation.

ERCs typically define mid-size or small companies by either number of employees (less than 1,000 employees for mid-size companies and less than 100 employees for small companies is within reason, but this may go as high as 500 employees for small companies) or sales of products or services that are in the field of the ERC. The cutoff for mid-size or small companies is subjective and at the ERC’s discretion, but should be perceived as fair to larger companies when considering benefits and the ability to contribute to the ERC. For small companies, fees are generally $1,000 to $10,000, and may be graduated. Fees for mid-size companies are generally $10,000 to $25,000, but again this is highly dependent on what is palatable to the ERC’s target industry.

In some cases, the ERC may choose to accept industry members’ fees on a quarterly or semi-annual basis, or alternatively to accept partial payment from multiple groups or departments in order to meet company departmental funding limitations or processes. Additionally, the ERC must balance the convenience of establishing contract and payment terms on the ERC’s preferred fiscal cycle (many times this is the university fiscal year) vs. being flexible to industry needs with regard to their fiscal cycles.

Even the definition of the “number of employees” can evoke discussion when recruiting industry members. Larger companies will sometimes argue that their research group focused on the ERC’s field is a small portion of the company and so the company should be able to participate at a mid-size or small company fee level. Many times, the company group with which the ERC works is in fact a smaller research or development oriented group, with smaller discretionary budgets. In the same light, companies may wish to share ERC information and technical results with affiliates or subsidiaries of the company. This is a difficult situation for ERCs. One suggestion provided by a number of industry partners is to define the company size by the number of employees that have free-flow access to that group’s internal technical information as part of their normal business processes. In that way, the ERC relationship does not create an artificial firewall to the group’s regular R&D information flow, since the ERC results flow in the same pathways, and to the same employees, as the group’s internal information. At the same time, the ERC is properly compensated for access to its information and results.

Membership fees are pooled and allocated to center functions according to the strategic and operational plans established by the center's leadership. Industrial members may provide additional support above the membership fees for activities such as sponsored research projects, equipment donations, intellectual property donations, or educational grants. Potential industrial members that have not joined the center but that contribute support for associated projects that fall within the scope of the ERC's strategic plan and are included in the Center's annual report are not considered members, but are designated as “affiliates.” Some centers use all membership fees to support research; some use them exclusively for support of student interns; others use membership fees for all operations.

### 5.1.2.4 In-kind Contributions in Lieu of Cash for Membership Fees

Centers' policies vary on how fees are paid—in cash, in-kind, or a combination. ERCs may find that in-kind contributions are valuable in the early stages, when equipment is needed and relationships require nurturing. Additionally, small companies that have unique equipment may not be able to pay a cash fee, but cutting-edge equipment donation can be of greater value to the ERC and other industry members who make use of ERC infrastructure or data from that equipment. If equipment is taken as in-kind, the ERC should strive to include maintenance and upgrade clauses in the agreement so as to protect against a downstream cash drain. For the purposes of membership fee payments, many ERCs value equipment at a 30-50% discount from industry retail value, not academic discount pricing. Additionally, many ERCs will limit overall in-kind contributions to no more than 50% of the overall pool of membership fees to assure a focus on cash membership fees, which provide liquidity and flexibility to meet the ERC’s overall program needs. This is even more important as the Center grows and prepares for self-sufficiency beyond the NSF funding cycle. Exceptions can be made for cash-poor small firms.

In 2012, ERCs reported corporate memberships ranging from 7 to 47 companies per center (averaging 23 per center). The distribution of membership among large, mid-size, and small companies depends somewhat on the industry involved, but most centers have members in all three size categories. Overall, small firms (<500 employees) and large firms (>1,000 employees) make up 43% and 48% of the members, respectively. In addition, several centers have federal laboratories as members. Some include industrial consortia. In that case, the consortium joins as a member, but the members of the consortium must also join individually in order to reap the benefits of the ERC. Overall, for established centers industrial/practitioner member organizations provided 9.4% of the total ERC direct support in 2012 (5.4% unrestricted cash, 1% sponsored projects, and 3% in-kind contributions). Including support provided by organizations that were not members, this percentage rises to 11.7% of ERC direct support for 2012.

## 5.1.3 Industrial Membership Rights and Responsibilities

Clearly identifying and promoting what the ERC expects of its industry members and what they can expect of the ERC is key to a strong, long-term, mutually beneficial relationship.

### 5.1.3.1 Member Rights

While appropriate industrial membership rights are usually industry-specific and should be determined by the ERC's leadership to optimize value to their specific industry members and the ERC, general guidelines from the ERC program can inform new centers on what has successfully provided value to industry partners. Rights of industry members are typically tiered for the level of membership as discussed in Section 5.1.2.3 and may include:

- Rights to serve on the Industrial Advisory Board (IAB) and the opportunity to serve as an elected representative on the Technical Executive Committee (TEC) or equivalent, if one exists. The IAB typically consists of all industry members in good standing and the TEC is elected by members of the IAB to provide the highest level of guidance to the ERC in an effective and efficient manner. The TEC is constituted to ensure the overall synergy of the research carried out in various research thrusts and to recommend to the ERC Director any needed mid-course corrections in research and/or personnel.
- Rights to receive a discounted university overhead rate, applied to any additional research in the field of engagement with the ERC associated with ERC researchers which the members sponsors outside of the Membership Fees. The university may request that this also requires up-front payment of the sponsored research fee to minimize the overhead burden to the university.
- Priority access over non-members to ERC facilities and instrumentation, sometimes at reduced fees.
- The right to request on-location short courses provided by ERC researchers, at reduced fees.
- Access to the ERC's secure website, comprising an electronic information network containing ERC reports, publications, and invention disclosures
- Intellectual property rights as discussed in Section 5.3.2

Whatever benefits are offered, the ERC must assure that these rights extend only to the industry member departments, internal groups, affiliates or subsidiaries that are included in the definition of ERC Industry Members in the agreement (e.g., those that share in the free flow of the member's internal technical information as discussed in Attachment 5-C).

### 5.1.3.2 Member Responsibilities

In addition to payment of the annual membership fee, industry members of an ERC are expected to undertake appropriate interactions with ERC leadership and researchers to help the ERC accomplish its mission. Members are encouraged to pursue a high level of engagement with the ERC to best guide the center and to take maximum advantage of all the ERC has to offer. Interactions come in many forms including:

- Visits to the member firm/agency by faculty and students

- Discussions at professional society meetings or conferences
- Visits to the ERC as often as practical to work collaboratively on research projects, mentor students, learn specialized techniques, and give special seminars

- Providing advice on developing the ERC strategic plan
- Reviewing overall progress against strategic goals

- Suggesting changes to the strategic plan, research, and education efforts
- Identifying areas for cooperation with industry or, in some cases, other institutions
- Reviewing invention disclosures and suggesting patent and copyright actions
- Critiquing the progress and direction of each research project
- Providing resources the research program may need
- Suggesting industry speakers for workshops and seminars.

While these and other types of interactions should be strongly encouraged with all industrial members, there are certain duties and responsibilities that are required of members and that must be part of the Industrial Membership Agreement:

- Meeting with the ERC a minimum of twice a year
- Developing an annual SWOT analysis and presenting to the NSF site visit team
- Reviewing progress on ERC projects
- Providing input on ERC strategic plans
- Providing feedback on proposed project plans.

## 5.1.4 Engaging Industrial Consortia, Regulatory Agencies, & Industry Associations

In working with external industrial consortia and with state and local governments—particularly those agencies involved in economic development—the ERC will need to meet specific consortium or agency goals while assuring that such interactions pass the test of leveraging the center's activities, augmenting the benefit to member companies, and contributing to student and faculty development. Several centers collaborate with state agencies in programs with small companies—from directed research projects with undergraduate students to state-assisted start-up companies based on center research as discussed below.

Some Centers have actively engaged their target industry's relevant regulatory agency or other non-traditional organizations in their programs. For example, the Food and Drug Administration (FDA) is actively engaged C-SOPS Industrial Advisory Board and Science Advisory Board[2]. Also, the engagement of the US Department of Agriculture (USDA) by CBiRC produces a distinctly positive relationship. ERCs should consider having regulatory agencies interact with the academic community and industry partners in ERCs where appropriate. Any regulated industry that is an ERC focus field should consider having regulatory bodies involved in a "neutral setting," to facilitate active interactions between faculty/students, industry, and the regulatory agency.

*CASE STUDY: In the case of C-SOPS, faculty taught courses at FDA to provide knowledge of current and future practices in continuous manufacturing. The course was attended by many FDA employees and provided critical thought into science-based regulatory processes. The FDA proposed regulatory guidance, such as Quality by Design (QbD) and Process and Analytical Technologies (PAT) pertaining to continuous manufacturing, and through such courses FDA personnel gained a clearer understanding of detailed continuous manufacturing processes. This reduces the amount of uncertainty for industry. The C-SOPS Director served on FDA committees that draft guidance documents. C-SOPS recognizes the value of doing this independently to develop Best Practices. The limiting factor is not money, but the time of the personnel involved. Through closer alignment of regulatory and industry practices, C-SOPS can ensure that technological advances will be more readily accepted by the FDA and can subsequently be incorporated into industrial practice, providing significant impact to both.*

Groups involved with standards development (e.g., ASME, IEEE) could be ERC education and dissemination partners. An ERC needing manufacturing capabilities might gain access to an industry group that could translate and manufacture outputs of the ERC and possibly collectively gain companies that would not join the center, but could add value to Center activities. In cases where the ERC has a significant life science / clinical focus, the ERC might consider engaging a Clinical Advisory Board, which is integral to the Scientific Advisory Board (SAB).

Several centers are participants in other federal programs (e.g., those of DARPA and NIST). On balance, most centers see such participation as beneficial. Benefits include the industrial relevance of the work, strong commitment and involvement by industry, and willingness of other universities to work together collaboratively. However, not every center finds these large programs beneficial. Disadvantages include “wicked timetables,” volatility of funding (causing dislocation in the amount of technical effort in a given project area), and the negative impact that industrial cost-sharing can have on the direct sponsorship of university research by the same companies, given a fixed company budget for support of university research.

Some ERCs—especially those whose mission focus is in public infrastructure development—partner with federal, regional, state, and even local government entities to test and deploy their technologies. The collaboration mechanisms and issues encountered in working with these non-traditional stakeholders are very different from those involved in working with industry and usually entail unique case-by-case features. An example is given in the following case study.

*CASE STUDY: The main data sources for U.S. severe weather warnings and forecasts of tornadoes and flash flooding are 159 National Weather Service (NWS) long-range radars. However, this system has coverage gaps, especially at lower altitudes. To address these gaps, the ERC for Collaborative Adaptive Sensing of Atmosphere (CASA) developed a paradigm to supplement the large radars by dense networks of small X-band radars. Traditionally, transfer of technology like this to the commercial weather enterprise was driven by NWS requirements and federal funding, but it has become hard for NWS to obtain the necessary funds. Therefore, rather than relying on federal resources, CASA has led a locally-driven model in which a regional catalyst brings together multiple private/public, local/national stakeholders to fund hardware and operational costs of a regional warning system. The goal is to create a replicable model for other U.S. urban areas. The platform for translational research and shared ownership is a 4-node radar network (expandable to 20 radars) that CASA is currently in the process of deploying in the Dallas-Ft. Worth (DFW) metroplex. Crucial to success of this research-to-operations effort is a contractual arrangement between CASA and a local organization known as the North Central Texas Council of Governments (NCTCOG). The NCTCOG brought together local towns and cities, stormwater departments, fire departments, TV stations, and local businesses to support the project. These organizations are bringing local resources (e.g., warehouse space, rooftops and towers for radar installations, network connectivity, electricity) at no cost to the project; they are also paying for installation and operations of the radar network and raising supporting funds through federal (e.g., FEMA) and state grants and local foundations. Members of CASA’s Industrial Advisory Board, which include radar manufacturers, systems integrators, and NWS, are bringing additional funds or equipment. Managing this public-private-academic partnership is complex and requires frequent communication and coordination among the various stakeholders. If successful, it will demonstrate CASA’s life-saving technologies in a densely populated metroplex and could lead to the installation of CASA radars all over the nation. CASA recently celebrated installation of the first radar in the DFW testbed at the University of Texas-Arlington with local stakeholders, who publicly welcomed the new CASA technology that will give them clearer, more precise weather information.*

## 5.1.5 Involving Foreign Firms

NSF recognizes that an ERC can have a global dimension, since many research and education challenges and opportunities require overseas collaboration to bring the best resources to bear on a problem. NSF policy permits foreign firms to be involved in an ERC if they agree to operate on a *quid pro quo* basis, exchanging personnel, sharing support, risks, benefits, information, and their own facilities to the same degree as all other participating U.S. firms do. The ERC must be diligent to assure that there is a true two-way and equitable flow of information between the ERC and foreign firms—the same standard as domestic firms. In 2012, about 22% of the 326 ERC industrial members were foreign firms. This is an increase from a decade ago, when the average was 10-13%.

[1] Source: National Science Foundation, Dr. Deborah Jackson; 2012

[2] Attachment 5-A provides a key to ERC centers and their abbreviations for the convenience of the reader throughout the chapter.