2.6 Partnership with Industry

2.6.1 Range of Interactions

ERCs interact with industry in multiple ways, and there is a spectrum of types of relationships between center personnel and the employees of the companies with which it interacts. Since ERCs are required to build multi-tiered industrial memberships, the most common mode of interaction is with companies who become members of the center. Typically, these member companies attend periodic Industrial Advisory Board (IAB) and technology review meetings where they receive information about ERC research progress, provide input about the direction of projects, and interact with center faculty and students. However, additional interaction modes within the context of the membership program are also possible and, in many cases, are highly desirable. These include member companies becoming actively involved in the ERC strategic planning process (discussed in the next subsection) or in the centerâ€™s research, education, business or membership development activities.

Participating in specific research projects, either as hands-on participants that perform some of the work required to advance the project or as mentors, generally involves member companies meeting periodically with ERC researchers to discuss the project progress and future directions. This mode of interaction can be formalized by inviting each member company to allocate a certain number of mentors to specific projects. Examples of participation in educational activities include industry providing guest lecturers, facilitating industrial internships for academic researchers, providing student stipend financial support, conducting workshops and short courses for both academic researchers and for representatives of other companies, supporting entrepreneurial education for ERC students and post docs, etc. Among these activities, a high-value opportunity that is rarely used is to request member companies to provide summer internships for young faculty. This mode of interaction is an excellent way to expand the training and the funding perspective of faculty, and is a fast way to accelerate the development of collaborative relationships between ERC faculty and member companies.

Member companies can also help support ERC industrial membership development by reaching out to other potential member companies and encouraging them to participate in the ERC and center business development activities, by helping ERC researchers evaluate the potential value of patentable ideas, and by helping to create and evaluate business plans for possible spin-off companies.

In addition to the modes of interaction just described, several other ways of interacting with industry are possible, many of which do not require a company to be a member. The most obvious of these is for companies to sponsor research activities at the ERC. In this mode of interaction, a company, or a group of companies, provide funding for specific research of interest to the company(-ies). Since these research projects often build upon ERC research, when such projects are of interest to companies that are not current ERC members, the opportunity to participate in this type of research projects provides an additional, very compelling argument for them to join as members, thus avoiding or minimizing IP conflicts between members and non-members.

Member companies also often sponsor research projects as a means to expand the scope of the ERC research in directions of interest. This creates opportunities for further leveraging research efforts. The first opportunity for leveraging is that a member company that provides additional support often becomes a demonstration site for ERC technologies, which can create a very compelling model for other ERC members to follow suit and also become more involved. Another is that, since ERC engineered systems often require the integration of multiple technologies, this kind of â€œassociated projectâ€• also creates an opportunity to pursue projects funded by multiple ERC member companies, which can join into â€œmini-consortiaâ€• of shared interests (more details later).

Cooperative research contracts also allow the sponsoring company to see the center and its students in a very positive light and the company will offer hire center students, especially if they have been mentored by the company or placed in industrial internships. In fact, some centers report that member companies consider the ability to access and hire center students as being the best by-product of the centerâ€™s research program and a highly valued benefit of center membership.

An additional, very attractive mode of industrial interaction is when industry is actually a true partner in the development of technology. This can take multiple forms, such as when a company is interested in adopting an ERC technology and needs to customize it for its own specific requirements, which often include addressing the

issues of safety, regulatory compliance, and marketing that typically fall outside the scope of ERC research. Another is when industry is capable of providing technology building blocks that expand the usefulness of the integrated system.

A useful way of promoting all of these interactions is to regard the ERC industrial membership as an ecosystem organized around a technology value chain. In this ecosystem, academic researchers provide the long-term fundamental research efforts required to conceive, integrate, and demonstrate new technologies. Industrial members engage in the value chain in multiple ways and play multiple roles. Some members are technology suppliers. They provide technology components that are needed for the technology to function. These can include equipment components, software, sensors, and control systems. Other members are technology integrators. Typically, these companies take components from other companies, and also from academic researchers, and build integrated systems. Suppliers of control systems are also often commercial integrators. Still other members are technology commercialization companies. They often take the responsibility for supplying the integrated system to end users. Another type of industrial member is the technology end-user. This type of member would use ERC technologies to make goods and/or to provide services to the marketplace. A final category of potential members are companies, non-government entities, and government agencies that engage in the management of technology operations. This includes companies that provide consulting services to other companies regarding the use of the technology (for example, environmental compliance experts), private foundations that are active in the promotion of certain technologies or are invested in proper uses of technology, and government agencies with direct regulatory responsibilities (i.e., EPA, FDA, DOE, FAA, etc.).

When the industrial membership program is regarded in this manner, the modes of interaction between academic researchers and industrial members become self-evident. As the role of each member company in the technology creation and commercialization process is clearly specified, then the companyâ€™s key interest is also made clear, and the optimum mode of engagement around ERC initiatives can be easily articulated

This ecosystem concept is also very useful in developing a strategy for attracting member companies. Typically, the end users of technology are everyone elseâ€™s customers. Thus, it is often useful to attract them first to the membership program. Once enough technology end users have joined the ERC, it is relatively easy to attract their suppliers. This concept is also useful in designing the multi-tiered structure of the ERC. It is relatively straightforward to understand the typical size of the different types of participants, and whether their corporate culture is favorable to supporting academic research programs, and if so, in which ways and at which level. For many ERCs, the top membership tiers are populated by technology end users, technology integrators, and large technology suppliers, while the lower tiers are often composed of small technology-component suppliers.

Finally, participation of government agencies with regulatory responsibilities needs to be carefully assessed. On the one hand, their participation can be attractive to companies interested in using the ERC as a forum for dialogue with the regulators, or who would like to engage the regulatory agency in the development or demonstration of a technology in order to facilitate the acceptance of the technology by the regulatory agency. These modes of interaction between academia, industry, and government can be very useful and can increase the relevance and the prestige of the ERC among industrial participants. On the other hand, companies could be concerned about exposure of their ideas and development plans in cases where compliance issues for the technology under development are not fully resolved. The best approach may be to engage in a frank and open dialogue with industrial members regarding the optimum way to engage the regulatory agency.

2.6.2 The IAB's Role in Strategic Planning

Meaningful involvement of the IAB in ERC strategic planning is usually beneficial for at least two reasons. First, it creates in the member companies a sense of â€œownership,â€• a stake in the success of the center. Second, it helps maintain the relevance and importance of technology development efforts. While the first of these two reasons is self-evident, the second one requires a bit more elaboration. Every ERC has a mission component that focuses on developing technology and transferring it to industry. Participation of the IAB in selection of technology development goals helps the academic leadership select the most critical targets, i.e., those that are of most tangible value to the companies that are the intended recipients of the technology. This is an important input that needs to be periodically updated, because the â€œmost valuable technologyâ€• is a moving target. As time goes by and technology evolves, and as companies participate in ERC research, their technology platforms will evolve, and goals need to be periodically assessed and updated.

In practice, participation of the IAB in strategic planning can be implemented in a number of complementary ways.

One very useful role for IAB members is to perform gap analysis. This involves answering questions, from an industrial perspective, such as: What are the most important unmet scientific and technological needs in your industry, and in your company? What would be the advances likely to have the largest impact, and why? What would enable your company to develop products faster, more reliably, and less expensively? Answers to these questions are both excellent guidance in selecting broad directions for ERC research and very good targets for industrially sponsored projects.

Another important strategic role for IAB members is to participate in â€œroad mappingâ€• discussions. ERC leadership teams should meet periodically to examine the relevance of center program components, assess their criticality and their potential contribution, identify program components that are missing or not sufficiently emphasized, and select potential changes to the research program that would help maintain its relevance and maximize its impact. These discussions are typically best implemented among a small group of committed participants. Involving a small group of senior industrial representatives in such discussions is often profitable, since it provides a broader perspective as well as a measure of objectiveness regarding the actual practicality and usefulness of proposed research efforts. Moreover, since most large companies are very familiar with road mapping as a standard practice of business development efforts, they can assist the academic leadership in the organization and the moderation of strategic planning workshops.

An additional good practice is for the ERC leadership to present proposed changes to the overall research program to the entire IAB during plenary meetings. This gives an opportunity to the small companies that typically belong to the lower membership tiers to provide their perspective and to help renew a sense of engagement in the long-term center strategy.

2.6.3 Agreements & Expectations

Each center is unique in terms of the industry to which it is connected. It is also commonly the case that the transformational vision established for a center brings together companies in a new value chain that did not previously exist. Therefore, the Director needs to determine how the center is positioned relative to their prospective industrial partners and what the technological value proposition for their center is. These aspects are important, as they dictate two components of establishing the centerâ€™s relationship with industry, which are the membership and confidentiality agreements. Imbedded within the membership agreement is the intellectual property management plan for the center. The membership and confidentiality agreements are discussed in greater detail in the Industrial Collaboration and Innovation chapter of the Best Practices Manual (Ch. 5), with examples of each included, so the discussion here will focus more on the strategic implications of these agreements on the center, which the Director needs to consider.

Prior to establishment of a centerâ€”i.e., before the formal awardâ€”the center must recruit potential industrial members that agree to join the center when it begins. At this point of the relationship with potential industrial members, the Director should have the general outlines in mind for how the membership and confidentiality agreements and intellectual property will be managed so that the companies can begin to understand the nature and expectations of the relationship. These items will ultimately require review by the contracting personnel at the lead institution, partner institutions, and member companies. The review and iteration with all the parties will consume at least several months, so it should be initiated immediately at the inception of the center.

Creation of the industry membership and confidentiality agreements and intellectual property management plan need to be done very deliberatively and should incorporate input from the companies that agreed to be charter members of the center. With this input, the initial draft of the agreements will be composed by the lead institution, which will then be circulated to the company partners and partner institutions for their comments. The goal of the activity is to create robust agreements so that companies who join after the founding companies can find the documents acceptable without further edits.

2.6.3.1 Industry Membership and Confidentiality Agreements

The Industry Membership agreement establishes what the member companies receive in return for their membership fees and the Confidentiality Agreement establishes how confidential information will be handled between the lead institution, partner institutions, and member companies. In principle, these two agreements can be rolled into one, but it is not uncommon for industry to want them treated separately. These agreements will need to be signed by the lead institution, each partner institution, and each member company.

From a center leadership perspective, the membership and confidentiality agreements are strategically important, as they set the parameters for the interactions between the signing parties. The membership agreement will state what the lead and partner institutions are contractually obligated to provide to the member companies in exchange for the company membership fees, as well as laying out the structure of the membership fees. It is common to have a fee structure that is dependent upon the size of the company as well as the rights the member company is obtainingâ€"e.g., whether or not the company is getting certain intellectual property rights. For instance, membership fees in some ERCs are as little as $1,000 per year, while others that provide free intellectual property licenses are as much as $250,000 annually with a three-year commitment. The agreement needs to also consider whether in-kind contributions from companies can be used in lieu of cash payments (generally in-kind payments are not a dollar-for-dollar equivalent to cash membership). If the center leadership team has decided that in-kind payments will be allowed, this should be clearly addressed in the membership agreement.

The confidentiality policy for the center needs to be either included in the membership agreement or be the subject of a separate agreement. It is important that the lead and partner institutions as well as the member companies understand and agree to the confidentiality policy, as the policy dictates how information can be exchanged. The policy needs to allow the academic institutions to freely exchange confidential information so the center can truly perform as a center. However, the confidentiality can be either a two-way or one-way agreement with the member companies. In either of these cases, the member companies need to agree to hold the center confidential information confidential within their organizations. However, companies might prefer not to provide the center with confidential information (a one-way agreement), so as to avoid contamination between the member companies. The choice of a one-way or two-way confidentiality agreement between the center and member companies should be made in conjunction with the founding member companies.

2.6.3.2 Intellectual Property

As mentioned above, how the intellectual property (IP) arising from the center will be handled must be addressed in the membership agreement. Importantly, the lead institution and all the partner institutions need to agree on how IP resulting from center-funded research (whether at the lead or partner institutions) will be handled vis-Ã -vis the member companies, and the center leadership needs to consider the strategic implications of the IP plan when it is established. Items to consider are: whether all member companies have the same IP rights (tied to membership fee structure); how long do member companies have to decide whether a specific piece of IP is of interest to them; and how are IP rights handled if more than one member company is interested. More details on IP, as it pertains to startup companies, can be found in Section 2.6.5.

Several relatively new considerations make the handling of IP even more critical for ERCs. First, patent law in the U.S. has shifted from first to invent to first to file. This situation needs to be managed by the center when sharing â€œin progressâ€• confidential information with member companies. A second complicating feature is the Gen-3 expectation that the ERCs will spin-off startup companies as part of their innovation activities. While unique IP is generally the key underpinning of an ERC startup company spinoff, IP generated by base-award NSF funding to the ERC must be handled as prescribed in the membership agreement. Therefore, it usually is not possible to â€œsequesterâ€• ERC-generated IP for a targeted startup company. Instead, the eligible member companies must all first decline to pursue the IP. Given the complexity of the issues surrounding IP management in the center, the Director needs to be sure there is a clear understanding of how IP will be handled amongst the lead institution, partner institutions, and member companies.

The culture of the industry represented by the charter members of the center is another important consideration in developing an intellectual property management plan. The companies in many industries aggressively pursue patents in order to establish proprietary market positions and therefore prefer exclusive arrangements with center-developed technology. Companies in other industries, however, are sometimes mostly interested in ensuring that they are not excluded from using a technology development and are more accepting of universitiesâ€™ providing broad member access or even allowing public access to technology developments through publication.

Best Practices Chapter 5 includes a discussion of IP management and delivery in Section 5.3.2.

2.6.4 Meeting Industry's Needs and Expectations: How Far to Go?

ERCs must find a balance between the practical, hands-on activities that are of most immediate interest to industry, and the long-term, fundamental research goals that are needed to advance the scientific mission of the center. The need to balance these two perspectives is in fact an opportunity that helps maximize both the relevance of the long-

term efforts and the scientific value of technology development activities.

One important observation is that a significant fraction of the â€œdisagreementâ€• between these two perspectives is often just a matter of semantics and interpretation. Most industrial members understand that technological advances are based on scientific progress. Likewise, many engineering academics enjoy and appreciate an opportunity to maximize the practical impact of their research. Thus, a relatively easy way of bridging the gap between the short-term perspective characteristic of industrial researchers and the longer (sometimes endless) time line of academics is to promote active discussion between both parties, preferably in the context of specific projects. In this respect, integration of project teams including both academic researchers and industrial mentors is a very useful approach for maximizing alignment of perspectives.

The preceding discussion notwithstanding, meeting industrial expectations is critical in order to maintain industrial interest. One way to accomplish this is to require every project to identify and spell out its technical and scientific deliverables, and to implement the practice of providing a timetable for completion of project milestones. This practice is standard in industry but is rarely implemented in academic research. Adoption of this and related practices, such as preparation of Gant charts and other project management practices can help create in industrial participants a sense of confidence that goals are being met and progress is being achieved, while at the same time giving the academic members the freedom to focus on the enabling scientific issues.

A more substantial way of meeting expectations and maintaining interest is to deliver what is promised, and to do so on a timely basis. This truism is not as easy to implement as one would hope. Specifically, when developing integrated technologies, research and development activities often must be carried out in a sequential fashion by different team members. Such coordination of activities is fairly common in industrial R&D efforts, but it is often outside the experience of academics, who tend to work in an entirely independent fashion. Once again, program management practices that are widely used in industry can be very helpful to academics who suddenly find themselves working interdependently.

2.6.5 Impact of Innovation Strategy on Member Companies

With the Gen-3 requirement that ERC innovation strategies will include technology transfer via startup companies, the Director will need to be able to explain how the center will handle startup companies relative to member companies. At first blush there would appear to be a clear conflict between the goal of translating technology to member companies versus translating technology to startup companies initiated by the center. Particularly worrying to companies is whether the center will hold back the â€œbestâ€• IP to be vested with startup companies. If the membership agreement has adequately addressed how center-generated IP will be handled, this concern should be alleviated.

Typically, any center-generated IP available for use in a startup company must first have been declined by the member companies. This progression needs to be considered if center personnel are hoping to initiate a startup company based on the IP in question. In reality, there will be many examples of center-generated IP that are still too early in the development cycle for member companies to be willing to license. For these cases, member companies are commonly supportive of the technology being further de-risked by a center-initiated startup company and may in fact want to establish some relationship with the startup. The advantage of moving funding for the technology translation work from base funding is the ability to explore additional funding opportunities with the startup company that are not available if the technology translation work only stays within the center. Additionally, moving the technology translation work into a startup company means that subsequent IP associated with the translational research is not convoluted with IP generated under the purview of the membership agreement.

The most complicated aspect of the centerâ€™s innovation strategy with respect to the member companies is when a startup company formed by center personnel becomes a member company. If the startup company pays a membership fee that includes IP rights, they have the same IP rights as any other member company. The aspect that needs to be appropriately managed by the center is when a startup company is launched, relative to the IP becoming available to member companies. Even when a center is working to be completely transparent with their member companies, the center researchers will know about potential IP before the member companies do, so this situation must be considered when the center launches a new startup. The concern of appropriately handing IP relative to center startups will be mitigated by the fact that IP rights mean that member companies have the right to negotiate a license for the IP. Therefore, the ultimate disposition of the IP is in the hands of the IP office of the university having ownership of the IP and not in the hands of the center.

CASE STUDY:

The Data Storage Systems Center at Carnegie Mellon University (1990-2001), began as a totally industry-funded center with several million dollars in funding from US companies who were threatened by competition from foreign (mostly Japanese) companies. Initially, the industry was so delighted to have a university involved in this area that they put almost no restrictions on how the money was used. Later, as the DSSC became more sophisticated in its research and as profit margins for the industry declined, industry attached more and more "strings" on how the money was to be used. The Center's Director became a broker for industrial research projects for Center faculty, and although the research was cross-disciplinary and all the technologies involved in data storage systems were being addressed, because each company had different objectives there was no systems-oriented focus. The ERC award was then sought and won, and with the NSF funding, long-range, systems-oriented goals were defined and pursued.

In its 10th year as an ERC, the DSSC received $4.8M in funding from 50 industrial members, which accounted for 39% of its total revenue. Membership fees ranged from $60,000 per year for Affiliate Members to $250,000 per year for Associate Members who received royalty-free access to the Centerâ€™s intellectually property. The ERCâ€™s research and education program involved 36 faculty, 14 postdocs and visiting researchers, 8 full-time research staff, 88 graduate students, and 23 undergraduate students.

Shortly after receiving ERC funding, the Center helped guide the industry into forming the National Storage Industry Consortium (NSIC), which helped to coordinate the long-term precompetitive research of the US Data Storage Industry as well as all the universities working in this area. In 1996, NSIC was involved in over $50 million in research. The DSSC did everything it could to support the consortium, even though a large part of NSIC funding went to other universities. For example, in 1998, the DSSC wrote a proposal and received funding for a Frontiers of Magnetic Recording Program that, over a three-year period, published over 192 papers and funded 87 students at 16 different universities. The NSF contributed $1.89 million to this program while NSIC contributed $3.37 million. The Director of the DSSC was also the Technical Director for this program. By 2002, the US Data Storage Industry was no longer severely threatened by foreign competition and NSIC was reincorporated as the Information Storage Industry Consortium (INSIC) and allowed foreign firms to become members, in order to better serve the worldwide information storage industry.

The DSSC has continued to thrive as a successful industry-funded center since graduating from NSF support in 2001. During its 25th anniversary celebration in 2008, the DSSC noted that during that period it had granted 132 masters and 200 PhD degrees, collaborated with 60 different industrial partners, spun off 6 companies with over 900 employees, and created 90 inventions and obtained 32 patents. In addition, the Center introduced 14 new and 60 modified courses into the Carnegie Mellon curriculum over those 25 years.