

**When Triple Helix Unravels:
Learning from Failure in Case Studies of Industry-University Cooperative Research
Centers**

**Presented as part of a Thematic Workshop
Understanding Cooperative Research Centers: Learning from Success and Failure**

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Abstract

Cooperative research centers (CRCs) are a significant and growing “triple helix-based” vehicle for promoting cross sector collaboration, knowledge and technology transfer and ultimately innovation. Although there is a growing social science literature on these organizational structures, the management and “best practice” portion of this literature have tended to emphasize success stories and to neglect descriptions and analysis of CRC failures. Unfortunately, such a strategy is inferentially and practically flawed since it instructs the practitioner with advice about “what to do” but fails to advise him/her about “what not to do”. Given this background, we present four mini-cases of CRC that were successfully launched but subsequently experienced serious problems and ceased operation. Analysis of four “failure cases” identified environmental and center transition factors that appeared to contribute to a center closing operations. There also appeared to a tendency in such center for multiple problems to appear and through neglect magnify their effects. Implications for triple helix organizations are discussed.

Key words:

Centers; Triple Helix; Outcomes; Failure

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There are no secrets to success. It is the result of preparation, hard work, and learning from failure.

- Colin Powell, Retired Chairman US Joint Chiefs of Staff and US Secretary of State

1. Introduction

Government-led industry-university cooperative – "Triple Helix" – research organizations (Etzkowitz & Leydesdorff, 1997) continue to spread (Etzkowitz, 2008). This trend has been particularly true for cooperative research centers (CRCs), organized units or organizations that perform research and that also have an explicit mission to promote cross sector collaboration, knowledge and technology transfer and ultimately innovation (Boardman & Gray, 2010). Cohen et al. (1994) identified over 1200 such centers in the U.S. in the late 1990s. While a more recent census is lacking, it is safe to assume a larger number of the 13,000 university-based or non-profit research centers listed in the *The Research Centers and Services Directory (2009)* meets the definition of a cooperative research center. Expansions of programs to support such centers have recently been announced in Australia (Australia MIISR, 2009), Finland (Finland MTI, 2008) and throughout the EU (Government Monitor, 2009) and elsewhere in the world.

Public policy and related interest in these vehicles for promoting technological innovation and ultimately social and economic benefits have helped stimulate a relatively large, if uneven, body of social science research. According to a review of the evaluation literature on U.S. CRCs (Gray, 2000), this literature can be grouped into at least three categories: *ex-ante* evaluations that focus on factors used to determine whether CRC programs and/or individual centers should be funded; interim evaluations that involve data collection while the research center is operating and focus on the effectiveness of CRC structure and processes; and outcomes evaluations that examine the proximal and/or distal outcomes and impacts of centers. Not surprisingly, some evaluations use multi-level evaluation (Gray & Sundstrom, 2009) for continuous improvement and learning (Gray, 2008). A collection of papers reflecting all of these foci can be found in a recent Special Issue of the *Journal of Technology Transfer* (Gray & Boardman, 2010).

Unfortunately, from a practitioner's standpoint, most of these studies have been conducted at the program level of analysis and provide little or no guidance on the factors that make individual centers successful. In general, this need has been met by a modest case-based "best practices" literature. In these analyses, a series of success cases or "stories" are presented to highlight strategies and practices that appear to be successful. Examples include Tornatzky et al. (2002) university-level cases presented in *Innovation U*, Roessner et al. center-level examination of the Georgia Tech Packaging Research Center and subsequent analysis of several Engineering Research Centers (Roessner, 2010), and Scott's project-level *Compendia of technology breakthroughs* (2009). While useful what all these studies have in common is an exclusive focus on successful universities, centers and projects.

We believe this strategy is short-sighted for a number of reasons. First, as the case study literature suggests (e.g., Yin, 2002; Ruegg & Feller, 2003), one can have much greater confidence in causal conclusions (e.g., internal validity) with a multiple case analysis that includes cases with varying rather than uniform levels of performance. In addition, considerable evidence suggests that valuable and unique lessons can be learned from failure. For instance Coelho & McClure (2005) argue that, "Recognizing failure is essential to success because it implies that core competencies have been identified" (pg. 2). In addition, Petroski (1994) suggests that failures in our increasing complex socio-technical systems lie hidden in the interdependencies of various system components and can only be detected when systems actually fail. Similar arguments come from analyses of both personal (Shepherd, 2009) and team failures (Kayes, 2004).

Given these circumstances, we believe it would be instructive to examine the circumstances and factors that have contributed to the failure of various cooperative research centers. Toward this end, we present four mini-cases from the U.S. National Science

Foundation (NSF) Industry/University Cooperative Research Centers (IUCRC) Program. Analyses focus on IUCRCs that successfully launched, operated at least a few years with NSF funding, then failed.

Our goals are to identify: 1) *Likely factors* in IUCRCs and their environments that contributed to failure; 2) *Common themes* in IUCRC failures; and 3) *Points of learning* for Triple Helix.

1.2 NSF IUCRC Program

The IUCRC program is the longest running triple-helix-based center program supported by the National Science Foundation. We have highlighted its key features elsewhere.

IUCRCs are university-based, industrial research consortia. The research performed in the centers tends to be strategic or preproprietary fundamental research and is carried out primarily by faculty and graduate students. IUCRCs follow a relatively standardized set of policies and procedures; members pay an annual fee (usually between \$30,000 and \$50,000 per year), and they get equal access to, and ownership of, all research and intellectual property, findings, know-how, and technology are transmitted through a variety of means, including periodic reports and semiannual meetings; and members get one vote on the center's Industrial Advisory Board (IAB). (Gray 2008, pp 81).

The IUCRC program currently supports about 45 centers that involve about 100 universities, about 700 firms, 600 faculty, 1000 graduate students, and 200 undergraduate students. Centers tend to be diverse in terms of budget (\$400,000 to \$7 million), number of research personnel (5 to 50), and number of industry members (8 to 40). Centers also represent diverse areas of technology: manufacturing, nano- and microtechnology, chemical processing, biotechnology, and advanced electronics, to name a few. Importantly, because of their consoritial format all research and IP is shared equally by all members.

At the program-level of analysis, the IUCRC program has had an enviable record of success. Program-wide statistics indicate firms and faculty are very satisfied with their partnership, faculty continue to publish in high quality journals, students earn advanced degrees and develop skills that are in high demand, firms report a variety of direct and indirect benefits and center research frequently result in commercialized technologies (Gray and McGowen, 2010). Not surprisingly, the picture at the center-level is not as uniformly rosy. In fact, a recent study by McGowen (2010) has revealed that 12 percent of the IUCRCs leave the program before the end of their first five-year award and another 26 percent do not complete a full ten-years of funding. While a few centers leave the program voluntarily to pursue other funding opportunities, we estimate nearly one-third of all launched centers ceased operation prematurely because they failed to satisfy the needs and expectations of one or more of the stakeholder groups involved in their triple-helix partnership. Below we attempt to shed light on what set of factors contribute to the failure of these centers.

2. Methodology

The IUCRC program has adopted a “customer-driven”, decentralized evaluation strategy that involves an on-site evaluator and observational and survey-feedback methodologies. The linchpin of the IUCRC evaluation system is the on-site, local evaluator. This individual is responsible for implementing a standardized assessment protocol on an annual basis including collecting qualitative data via observation and interviews and quantitative data via the “process/outcome” questionnaire (Gray, 2008). The cases described below were prepared based on annual case reports prepared by the on-site evaluator.

3. Case Studies of of Early Failure

3.1 Center A. Center A was a multi-university IUCRC based in a U.S. commonwealth territory during the early 1980s that focused on pharmaceutical manufacturing. The managing site was at moderate-sized public university with partner sites at two small nearby private universities. The center began operations with seven industrial members and about \$500,000 in total funding.

At launch the center appeared to have a number of strengths. First, it was located in an area that had a large concentration of pharmaceutical manufacturing firms. In addition, the participating universities had a long track record of performing contract research for those firms. Further Center A was the brain-child of the managing university's dean so it had strong

support from the primary university. On the negative side the participating universities only had Masters degree-level chemical engineering/pharmaceutical science programs. The memberships came from local units of the participating firms, none of whom had on-site R&D capabilities. Finally, center leadership was assumed by a senior but non-tenure track faculty member.

While Center A operated for a couple of years, it never really reached the level of research performance and cohesiveness demonstrated by most successful IUCRCs. Within three years of start-up the center began to close its operations. In the case of Center A, it is clear that a number of deficiencies contributed to its demise. First, while the university scientists and local firms were very comfortable engaging in one-on-one research, moving to a consortial form of collaboration created a number of problems. First, firms were reluctant to discuss and share the more applied problem-solving research they had been doing with the local universities with their competitors. While the center tried to move toward a more fundamental precompetitive research program, this caused its own problems. First it became clear that the participating Masters-degree granting universities did not have capabilities to perform this kind of research. Further the sponsoring firms, lacking an R&D function, lacked the absorptive capacity to both define and exploit these kinds of studies (Zahra & George, 2002). Finally, as the center began to unravel, it became clear that the non-tenure track director did not have credibility with the participating faculty nor the political clout necessary to hold the center together. In the final analysis, it became clear that Center A lacked the ingredients necessary to become a successful IUCRC and was forced to close down.

3.2 Center B Case. Center B was launched in the mid-1980s and focused on topics related to molecular biology. Center B was novel in a number of respects. First it was the first IUCRC to conduct research targeted at the quickly maturing biotechnology-based pharmaceutical industry (Blumenthal et al., (1996). It adopted what was then and still is a very high annual membership fee of \$75,000. It also was one of the first multi-university IUCRCs supported by NSF. It began with two universities and eventually added a third, all in relatively close proximity. It is also worth noting that each participating university was considered nationally, if not internationally, prominent in one or more biotechnology-related areas. Finally, the center adopted a novel management structure wherein a state-funded science and technology agency served as the organizational home for the center and provided its management support.

Center B got off to a very good start from both a financial and technical standpoint. By its second year of operation the center had grown to five members and had an operating budget from all sources that approached \$750,000. The center attracted proposals from some of the participating university's strongest faculty. Members seemed very pleased with the quality of the research proposals submitted by the participating faculty as well as the early results that were produced. Concurrently, about five additional firms were evaluating the center's research program and were actively considering membership. Unfortunately, within two years the center's membership had declined to two firms, total center funding declined to about \$300,000. Not surprisingly, interest in submitting proposals, especially by high profile investigators, had already begun to diminish. One year later, the center's leadership decided to not submit a renewal proposal to NSF (which would have provided a second five-year award) and began closing down the center.

What caused the demise of Center B? It had a number of things going for it. First, it possessed a capable and highly motivated leadership team including individuals who had worked in the bio-pharma industry. Collectively, the three universities had one of the most well-respected groups of faculty in the country, if not the world. Finally, Center A was partnering with a fast growing industry that had "deep pockets" and was not reluctant to invest large sums of money into university research (Blumenthal, 1996). Interestingly, it was not the center's very high fee nor novel multi-university structure and external management structure that led to its downfall. In our opinion, two factors were critical in the decline and eventual demise of this center: the biotechnology industry's desire for a strong exclusive intellectual property (IP) position and the large amount of funding readily available to faculty from other federal sources.

Most significantly, it gradually became clear that firms involved in the highly competitive and proprietary-focused biotechnology industry were not comfortable with a consortial center model wherein firms shared what was supposed to be pre-competitive research. Two failed

member recruitment attempts during this period vividly illustrate this phenomenon. In one case, firm scientists favorably reviewed the center's operations and research program and recommended joining the center only to be overruled by its corporate lawyers. The lawyers argued even if the center pursued a relevant and relatively independent pre-competitive research program there was a chance that program might accidentally coincide with internal research that would be used to support exclusive patent claims. The lawyers successfully argued that the potential risk to the firm's IP claims posed by participating in Center B was too great to justify membership. In another case, a firm enthusiastically reviewed Center B's research capabilities and gave every indication they would join but did not. One month later that firm signed a \$500,000 exclusive research agreement with one university site that gave it first-refusal rights to all IP created under that agreement. Gradually, Center B's dues-paying members appeared to also conclude that the risk vs. reward involved in consortial research did not justify their continuing involvement in the center. One-by-one the center's founding members decided to not continue their participation in the center.

Although the biotechnology industry's aversion to consortial research would have eventually doomed Center B, another factor, the government funding environment faculty scientists experienced, helped weaken the university's side of Center A's partnership. During this time period, the National Institute of Health (NIH) was beginning to experience the budget increases that would eventually lead to a commitment to double its budget beginning in 2003 (Korn et al., 2001). In spite of the fact that Center B faculty appeared to enjoy and benefit from interacting with industrial members, as soon as it became clear to faculty that a well conceived center proposal might result in a \$50-100,000 two-year award while a successful NIH proposal might yield a four-year \$2-3 million award, faculty interest in submitting their research to Center A began to wane.

It is worth noting that these two factors appear to continue to work against the development of successful biotechnology-focused IUCRCs. While NSF has developed numerous successful IUCRCs in a variety of scientific and technical fields, with the exception of centers focused on bio-pharma manufacturing processes (something firms are willing to collaborate on), few IUCRCs focused on biotechnology-related issues have been launched and fewer have passed the test of time.

3. 3 Cases of Late Failure

3.4 Center P: Successful, Three-University Center that Failed in Year #11

Center P successfully launched and operated for five years as a single-university IUCRC, transitioned smoothly to a three-university IUCRC, expanded to become a model IUCRC with more than 50 member organizations in its seventh year, operated through its tenth year. In its 11th year the Center dissolved.

3.4.1 Development & growth. Center P began in the late 1990s as a single-University IUCRC, operated from a large, research-oriented, state university for five years, serving mainly the chemical industry and a few manufacturers. By its fourth year the Center had 25 member organizations, a research laboratory with \$4M worth of testing equipment, and a research budget over \$1M per year, with IUCRC funding supplemented by State grants, NSF research grants, and industry contracts. Center P had a half-time director, a half-time administrator, and affiliated faculty scientists in three departments. The Center produced an impressive flow of scientific publications and graduate degrees, and represented a model NSF IUCRC.

After its first 5 years, Center P joined with two state universities in other regions of the U.S. to form a multi-university IUCRC. Both partner universities ran independent, industry-funded research consortia with complementary research programs. The new Center added research thrusts at the new sites that attracted sponsors among defense contractors, aerospace firms, and the auto-makers, in addition to charter members in the chemical industry.

The new, three-university Center received its second 5-year NSF IUCRC award in the early 2000s, during an economic downturn, and still retained a total of 34 member organizations. Of these, half consisted of non-voting "affiliate" members that paid 40% of the regular member dues, had access to the Center's research, but had no rights to commercialize it. Although affiliate members had no vote, the director negotiated one-to-one with them to design

research projects that met their needs, often in exchange for in-kind contributions of equipment and testing materials.

Center P grew rapidly, despite losing a few memberships in the chemical industry when member companies merge. After two years as a multi-university IUCRC it had 34 voting member organizations and 19 affiliate members. Its sites at all three universities had half-time administrators who managed relationships with the member organizations affiliated through their sites. Each university had four or more Center projects specifically designed for, and primarily funded by, one or two member organizations. Affiliate members continued to negotiate privately for projects on the Center's research agenda.

3.4.2 Decline & dissolution. Two years after the multi-university IUCRC started, the founding director of Center P left. A scientist at the lead university who had worked with the Center since it opened reluctantly took over the post. Unfortunately, the lead university did not appear to appreciate the workload and responsibility involved in managing the center and did not give the new director release time for the role. The new director continued to work as a full-time academic and delegated leadership of the Center to the half-time administrator.

Two years later the Center lost its long-time administrator. The lead university named a replacement with a nominal commitment of 20% to Center P, in addition to another, full-time job on campus. Until then the Center had maintained relatively stable operations. At the end of the fourth year as a multi-university IUCRC, Center P had 26 voting members, 15 affiliate, and 8 in-kind-only members.

Center P approached the end of its 5-year NSF IUCRC award with a leadership vacuum. Neither the new director nor site directors at the two other universities took the lead on writing the renewal proposal. Even after a year's extension from NSF, the Center still had no director willing to lead its second five years as an IUCRC. The Center still had 15 voting members when it dissolved after slightly more than 11 years.

Despite the failure of the IUCRC, many of the research projects continued at the three university sites. At the lead university, scientists continued to conduct contract research for several of the member organizations. Each of the two partner universities re-opened the industry consortia they had started before joining the IUCRC, and at least one is prospering today.

3.4.3 Failure factors. One obvious factor in the failure of Center P as an IUCRC was the lack of an effective succession planning process at the host university that resulted in the unfilled leadership vacuum left when the founding director departed after seven years. The reluctant, replacement director did not exercise leadership, and realistically could only have done so without some release time from some academic duties. Regardless, the Center's research program continued largely as before, with most of its industry support, for another three years. The Center's part-time site administrators managed day-to-day operations, and faculty scientists managed relations with industry members, including some recruiting. In effect, members of the Center's leadership teams and faculty scientists compensated by taking on parts of many of the leadership tasks left undone by an inactive, executive director. Unfortunately, the task of leading and drafting the proposal for renewal of the NSF IUCRC award required a single, Principal Investigator to take responsibility.

A second, contributing factor in the Center's failure involved a management vacuum left by the departure of the Center's half-time administrator. The nominal replacement, an already overloaded employee, had no time for the job. For all practical purposes, the Center had no staff at its main office in its ninth year, when it should have been preparing to renew its NSF award. Though the faculty scientists at the lead site continued their research, and the two other sites operated as usual, the day-to-day work at the lead site fell behind, notably billing members for their dues.

A third, less obvious but perhaps more fundamental factor in the failure concerned the lack of institutional commitment by the lead university. The dean of the college that launched the Center and campus research officers declined to arrange released-time for a faculty member as replacement director, did not support hiring a replacement for the departing half-time administrator, and opposed a bid by one of the partner universities to take over as lead site of the multi-university Center. A difference in any of these decisions might have led to a different outcome.

Another non-obvious factor in the failure of this IUCRC concerns the lack of a cohesive group of industry stake-holders actively engaged with the university on behalf of the Center. Under similar circumstances at other IUCRCs a very invested and cohesive industry group might have lobbied the university for more resources and commitment as a group. Instead, the industry members maintained relationships mainly with individual faculty scientists, especially at the lead university.

Center P's one-to-one research funding approach contrasted with the collective approach in other IUCRCs. Ideally the IAB cooperates to define a shared research agenda of projects of interest to many of the member organizations. At Center P, the IAB had little input into the research agenda, because decisions had been made one-to-one. Perhaps as a result, many member representatives did not even attend IAB meetings. Many of the member organizations sent different individuals to IAB meetings. As a result, the IAB had no appreciable continuity, and developed no cohesion as a group. The IAB chairperson for most of Center P's history was the CEO of a small, local firm – one of very few individual, industry representatives who came to more than two or three IAB meetings. In a Center with a more engaged IAB, multiple industry representatives can advocate for their Center with the host universities. At Center P, the IAB never operated as Board, and took no advocacy role.

3.5 Center C: Successful Two-University IUCRC that Failed in Year #20

Center C developed and prospered for ten years as a single-university IUCRC, expanded to a 2-university IUCRC, continued an expanded research program through its 20th year, then closed.

3.5.1 Development & growth. Center C opened as an inter-disciplinary, industry-university research consortium at a research-oriented, state university in cooperation with one of the National Laboratories in the late 1980s. It received a NSF award as a single-university IUCRC in its first year, funded mainly by member organizations in the chemical and pharmaceutical industries. The Center operated with about a dozen members for its first five years under the leadership of its full-time, founding director, who then retired.

In the early 1990s a second, full-time director actively led Center C in obtaining a second, five-year IUCRC renewal award from NSF. The staff included a full-time administrative assistant and a full-time book-keeper. The Center had a budget of about \$500K and a dozen member organizations supporting research by 9 scientists at 3 university campuses and a national laboratory.

Center C became a model IUCRC in the 1990s. Representatives of its member organizations cooperated in a cohesive IAB to guide its research agenda. The 12-member Board selected 9 to 11 projects for funding, based on collective deliberation, and supported the research program with contributions of testing equipment, supplies, and use of their facilities. Center C produced a steady stream of scientific publications and graduates, and around its tenth year, invention disclosures and a patent applications.

After ten years, Center C's funding as a NSF single-university IUCRC ended. The director had planned to expand Center C to a multi-university IUCRC with a broader research program with some new specialties. Negotiations with two, potential university partners took longer than expected. Proposals by faculty scientists for a new research thrust at one prospective partner site did not interest the current IAB, and the partner site did not have enough industry sponsors to support the new research area. At another state university, the prospective site director was an untenured faculty scientist who struggled to find enough, committed industry support. The first proposal to NSF for a multi-university IUCRC was rejected.

In Center C's 13th year, a second proposal to NSF for a two-university IUCRC succeeded, with a total of 20 member organizations through the two universities. The Center operated three years without an IUCRC grant, relying on its industry support and individually funded research by its scientists, including NSF project grants. During the transition the director reduced to half-time to cut costs. The site director at the second university tried, with little success, to take over some leadership tasks, including member liaison. Within a year the Center hired a 15%-time co-director of industrial relations.

3.5.2 Decline & dissolution. Center C struggled after making the transition to a two-university IUCRC, partly because the lead university site discontinued cost-sharing support.

Through the Center's first decade the lead university contributed a full-time administrative assistant, an accountant, and at least part of the director's salary. This support ended around the time the first multi-university IUCRC proposal went un-funded. The Center then had to use external funds to support its administrative assistant and other staff. The executive director took another job, reduced to 10%-time long enough to hire a part-time, interim director, and then resigned.

Two years and two interim directors later, one of the Center's founding research scientists at the lead university took over as Center director. Meanwhile at the second university, the site director had resigned, a second director had taken over and resigned, and an associate dean had been appointed as director. The new site director suffered an extended illness, and Center C's faculty scientists at the site cooperated to manage relationships with the remaining 3 member organizations there.

By the end of the Center's 15th year the Center still retained 19 member organizations. This reflected both the loss of one or two members each year and compensating gains from recruiting. The second university site continued to retain only 2 to 3 members. Unfortunately, when the new director took over, several current member representatives expressed dissatisfaction with the Center's management and/or research program during the preceding years of interim directors.

The new director's tenure coincided with the economic decline of 2001, which hit Center C's member organizations in the chemical and pharmaceutical industries particularly hard. That year Center C lost five members. The next year another four members withdrew.

By the end of its 19th year of operation, Center C had only eight members, including two non-voting members, allowed when the Board agreed to a second category of membership. Center C had fallen below the minimum membership support needed for renewal of the NSF multi-university IUCRC award. The Center sent a renewal proposal anyway, including letters of interest (not commitment) from some prospective members. It was returned for clarification, and NSF funding expired.

Center C's director, with another, newly appointed director at the second university, conducted energetic (some said "heroic") campaigns to recruit enough new members for a minimum IUCRC proposal. These efforts proved unsuccessful. Center C's director and site director both announced resignation after the Center's 19th year. An assigned, interim director closed the center a year later, after overseeing completion of projects for the remaining industry members.

3.5.3 Failure factors. At Center C, as in the other case of failure at Center P, a contributing factor involved turnover in the role of center director. At Center C, however, the highly effective director wanted to stay, but left because the host university withdrew financial support for the Center, and specifically for the director's salary. Appeals to the lead university by members of Center C's active and supportive Industry Advisory Board failed to regain even limited, financial support from the host college.

Turnover and inexperience in the role of site director at the second university site probably contributed to the failure of Center C as a multi-university IUCRC. The initial site director at the second university site, an un-tenured faculty member, had little experience with industry, and had little success in recruiting member organizations, even on a sabbatical leave from teaching. The first director was replaced after less than two years. The role had three more incumbents in the subsequent five years, all with full-time academic jobs. The second university site struggled the whole time to attract even the minimum membership support required for the site to qualify for the NSF award.

The economic downturn of 2001 clearly contributed to the loss of at least 9 of Center C's member organizations in the chemical and pharmaceutical industries in a period of just two years. However, unquestionably the chaos the center went through during its leadership vacuum undoubtedly played a role in their decision too. The Center never recovered from this setback, which amounted to the loss of critical mass of membership.

4. Discussion

Based on our four cases, it looks like a variety of factors and a complex set of processes can contribute to the demise of an IUCRC. Not surprisingly, our analyses suggest that centers

need certain capabilities to succeed and the absence of some key ingredient can contribute to failure. For instance, the lack of doctoral-level program at Center A, certainly was a key reason for its failure. Obviously, this is something we could have inferred from studying the characteristics of successful centers. However, our results also suggest that even robust and successful centers can unravel if they confront a hostile environment and/or mishandle key transitions established centers must navigate. In addition, centers appear to be particularly vulnerable when they have to grapple with multiple and/or cascading challenges.

Our analyses suggest that a variety of environmental factors can contribute to the demise of a center. Attempting to form a consortial partnership in an industry where firms are averse to sharing research results with other firms (Center B), or simply have a history of working in a more one-on-one fashion with the PIs (Center A and C) can prove challenging. In addition, attempting to maintain the interest of talented faculty when large sums of extramural research support is readily available from other sources (Center B) can be difficult to overcome. Finally, maintaining the commitment of firms that are sympathetic but lack absorptive capacity to utilize these findings is probably a losing battle.

At the same time even robust and initially successful centers will encounter transitions that, if not handled properly, can cause them to lose momentum and eventually unravel. While previous research and analysis has pointed out the importance of leadership in successful centers, our cases illustrate the frequency with which founding directors depart and highlight the importance of succession planning in sustaining successful centers. Both Centers P and C were quite successful for an extended period of time but eventually suffered when less capable and dedicated leaders assumed the directors role. A related issue is institutional commitment. In both of the cases, the host university failed to demonstrate the willingness to invest the resources necessary to attract a qualified and motivated leader. During a period of interim or reluctant leaders, additional problems surfaced at these centers. In our view, another factor that would contribute to a poor outcome from a leadership transition is a lack of cohesive and commitment by the IAB. In truly consortial centers, a group of member firms have effectively lobbied the host university to commit the resources needed to sustain a center. However, because Center P used a more one-on-one mode of research sponsorship, its members failed see and/or utilize the influence they could wield as a unified group.

The final lesson embedded in our cases appears to be the extent to which centers that fail actually confront multiple and cascading challenges. Center B simultaneously had to cope with declining interest by member companies and faculty at the same time. Individuals associated with Center A tried to make it work but the challenges posed by a lack of doctoral level research, member firms with limited R&D capabilities and a director who was not tenure track were too much to overcome. Both Center P and C attempted to manage a leadership transition without much institutional support and while confronting other problems including a declining economy. In both cases, the inability to handle a fairly routine management challenge, replace the founding director, contributed to and exacerbated other center deficiencies (e.g., a lack of cohesiveness among the member's consortia) and resulted in the demise of what had been a successful center.

5. Implications for Triple Helix Organizations

IUCRCs are prototypical triple-helix organizations. In order for a center to be successful requires a complex balance of capabilities by each stakeholder group and the ability to meet the expectations and needs of the other stakeholders. Our analyses suggest that centers can be launched successfully but may falter if they possess some fatal flaw like limited research ability on the part of university or limited absorptive capacity by industry. However, our analyses also suggest viable centers can unravel when mature centers fail to address relatively minor problems or challenges like the transition to a new director. Obviously, it is in the best interests of centers and the stakeholder groups they serve to understand what key challenges/transitions they are likely to face and prepare to handle them quickly and effectively.

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