

Encouraging Industry-University Partnerships

Report from the Engineering Advisory Committee Subcommittee on Industry-University Partnerships

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1. Charge to the Committee

In Spring of 2007, Engineering AD Richard Buckius appointed an Engineering Advisory Committee Subcommittee on Industry-University Partnerships (**EAC-UIP**) to provide input to the Directorate. EAC-UIP includes representatives from key stakeholder groups that participate in or sponsor collaborative industry-academic research. Specifically, the members are drawn from universities, large companies, small businesses, not-for-profit foundations, and the venture capital community. They include members of the ENG AdCom, SBIR AdCom, and two National Academies groups, the Government-University-Industry Research Roundtable (GUIRR) and the University Industry Demonstration Project (UIDP). Since its inception, the Subcommittee has worked closely with members of the Engineering Directorate (**ENG**), several of whom have participated in all meetings.

Dr. Buckius charged EAC-UIP to **recommend strategies to further strengthen NSF-wide efforts to promote industrial partnerships that advance the frontiers of research and promote technology innovation**. The first objective – defining major technological challenges industry faces over the next 5-10 years, where accelerated investments in research could offer the potential for major breakthroughs – was deferred when the NAE launched its project to define Grand Challenges in Engineering. That effort has now come to completion. Our Subcommittee believes their project has been comprehensive, and does not require further action on our part unless the ENG Director has specific questions in mind.

Instead, EAC-UIP focused on Dr. Buckius' second objective: reviewing NSF's role in knowledge transfer and assessing the need for a more proactive approach. We began by reviewing the statutory landscape for industry-university partnerships. This was laid out in the Bayh-Dole Act of 1980, which addressed federally-funded research at universities and small businesses. In particular, it regulates how licensing rights to federally-funded inventions can be transferred for purposes of commercialization.

As we looked into the issues of knowledge transfer, we reviewed the work of the National Academies' Government-University-Industry Research Roundtable. This group – with stakeholder representatives from the Federal government, universities, and industry – has become more active with the recent formation of a University Industry Demonstration Project (UIDP), focusing on software to facilitate negotiations of university-industry intellectual property agreements.

Since ENG's Dr. Kesh Narayanan already represents NSF's interests on the UIDP, the Subcommittee decided to focus our own efforts on NSF's role in encouraging closer ties between industry and universities. Specifically, we have attempted to **identify structures and processes that ENG can implement in order to increase access by industry and other research customers to NSF-supported discoveries**.

This report presents our findings and recommendations. Section 2 describes our efforts to analyze how industry currently participates in NSF-funded projects and identify where increased participation is desirable. In Section 3, we discuss the various forms of cost-sharing and their

importance in solidifying university-industry partnerships. Section 4 lays out a strategy for incentivizing greater participation in the future.

2. Industry Participation in NSF-Sponsored Research

The increasing national attention to competitiveness creates a natural landscape for university-industrial partnerships. Consider the innovation “supply chain” depicted in Figure 1. In this context, traditional NSF-sponsored academic projects can be viewed as transforming research funding to knowledge through fundamental research and discovery. Developmental activities further transform that knowledge, addressing the series of steps required to commercialize research output as innovative processes and products. Industry – and small business, in particular – occupies a key role in this staged transformation, by establishing the engineering and manufacturing “readiness” of the new technology, acquiring and positioning the associated IP, and developing the processes needed for market viability.

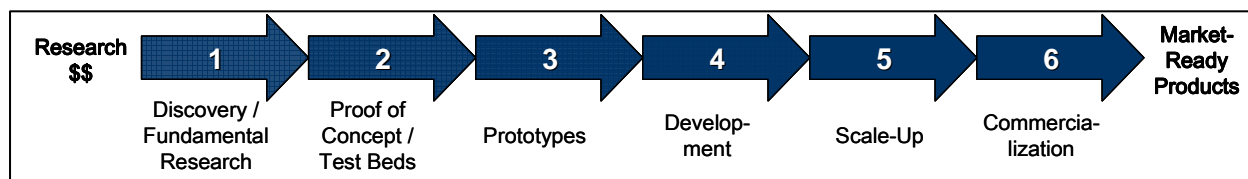


Figure 1. Innovation “supply chain”

This concept provided a framework for our discussions. Traditional NSF programs have centered on the first stage (discovery and fundamental research), and that certainly must remain the focus of attention for the Foundation. However, as Dr. Bement noted in a talk last year, “In the face of increasing competitive pressures, industry has largely abandoned long-term, high-risk research. The vacuum left by this retreat is being filled in large part by creative and productive partnerships between industry and universities.”

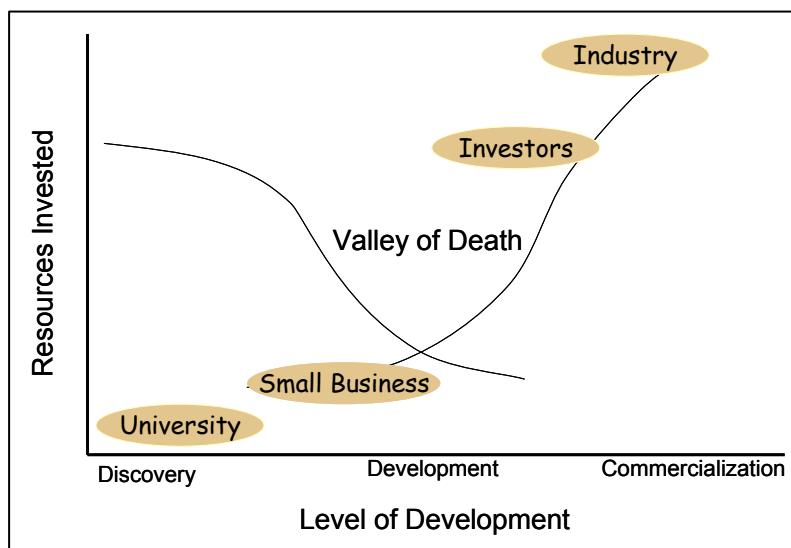


Figure 2. Gap in innovation investments, aka “valley of death”

With the decline of R&D investments in the private sector, there is an increasing gap in the next 2-3 stages; that is, industry increasingly waits until the scale-up and commercialization stages to pick up innovations. Commonly called the “valley of death” (Figure 2), this gap in the supply chain is worrisome given the national importance of maintaining industrial competitiveness. EAC-UIP therefore made a special point of exploring what role NSF can, and should, play in stages 2, 3, and 4.

2.1. Workshop on NSF University-Industry Partnership Programs

EAC-UIP began by reviewing the types of university-industry partnership programs currently in place at NSF and related Federal agencies. To facilitate this effort, we convened a workshop at NSF in August, 2007. Table 1 lists the programs included on the agenda and the individual who prepared information on each. Prior to the workshop, each representative distributed a white paper describing the experiences of the program, focusing on technology transfer activities to date, challenges, and lessons learned. He/she also made a summary presentation at the workshop and responded to questions from the Subcommittee.

It was clear that all participants in the workshop – program directors and members of the Subcommittee alike – believe that university-industry partnerships are of long-term strategic importance. Partnerships also serve to strengthen the individual research projects to which they apply. Consequently, actions by NSF to requiring or endorse industry participation help incentivize academics to form alliances outside the academic environment. They also send an important message to the public about the project’s relevance – and that industry and government are both vested in R&D.

Table 1. Programs included in the August 2007 workshop

<i>Program</i>	<i>Workshop Participant</i>
NSF cost-sharing/ incentives partnerships	Jean Feldman (BFA)
OLPA partnerships/collaborations	Susan Mason (OLPA)
DARPA partnerships/collaborations	Mike Foster (CISE)
NASA Mentor Protégé Program	Dave Grove (NASA)
Cyberinfrastructure partnerships/collaborations	Jose Munoz (OCI)
EHR partnerships/collaborations	Wanda Ward (EHR)
Engineering Research Centers (ERC)	Lynn Preston (ENG)
Grant Opportunities for Academic Liaison with Industry (GOALI)	Joe Hennessey (ENG)
Industry/University Cooperative Research Centers (I/UCRC)	Alex Schwartzkopf (ENG)
Materials Research Science & Engineering Centers (MRSEC)	Maija Kukla (MPS)
National Nanotechnology Infrastructure Network (NNIN)	Larry Goldberg (ENG)
Nanoscale Science & Engineering Centers (NSEC)	Bruce Kramer (ENG)
Partnerships for Innovation (PFI)	Sally Nerlove (ENG)
Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR)	Joe Hennessey (ENG)
Science & Technology Centers (STC)	Nat Pitts (OIA)

The workshop discussions also made it clear that industry and university participants have very different notions of the nature, scope, and importance of “innovation,” as compared to other research and educational activities. Figure 3 depicts these perspectives, contrasting them with those of NSF and the current political sphere. Given the differences, the Subcommittee believes it is particularly important that potential partners be encouraged, or even required, to have explicit, up- front discussions about their goals and desired outcomes, with the intent of arriving at a set of shared outcomes that can be used to guide partnership activities.

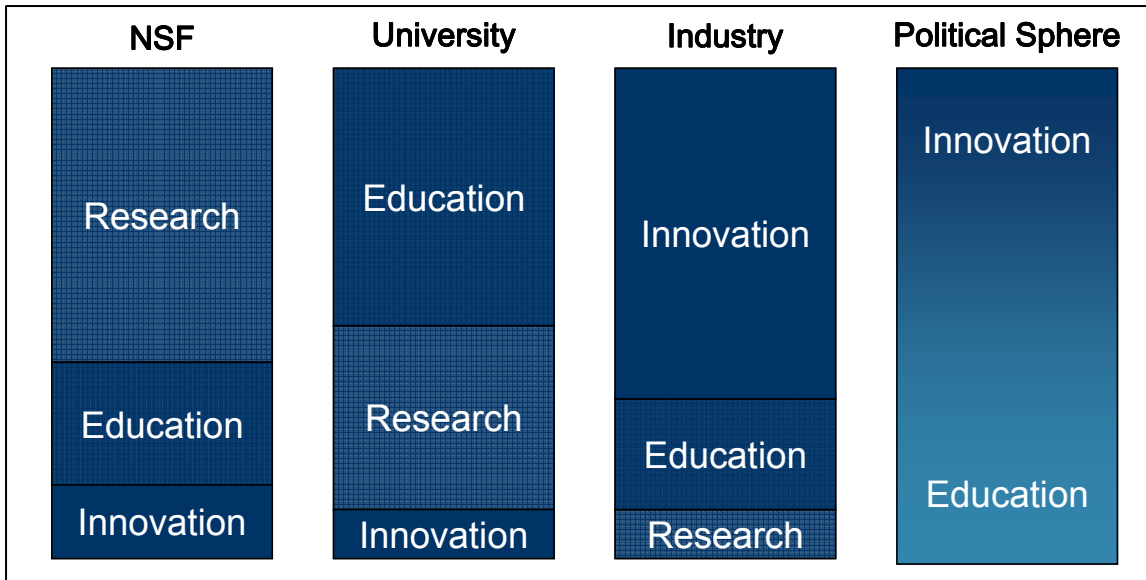


Figure 3. Perspectives on the role of innovation; block height reflects how broadly the concept is interpreted in each community

2.2. Partnership Portfolio Analysis

Following the workshop, EAC-UIP worked with ENG staff to design a portfolio analysis that would determine where and how the Foundation as a whole currently invests in university-industry partnership programs. The objectives of the analysis were to:

- Identify at which stages in the supply chain investments are currently being made
- Estimate the relative investments in terms of NSF versus industry funds
- Distinguish between large- and small-business involvement in NSF-sponsored projects

Table 2 lists the eleven programs that were examined in detail as part of the analysis.

Table 2. Programs included in the portfolio analysis

ERC	Engineering Research Centers
GOALI	Grant Opportunities for Academic Liaison with Industry
I/UCRC	Industry/University Cooperative Research Centers
MRSEC	Materials Research Science & Engineering Centers
NNIN	National Nanotechnology Infrastructure Network
NRI	Nanoelectronics Research Initiative
NSEC	Nanoscale Science & Engineering Centers
PFI	Partnerships for Innovation
SBIR	Small Business Innovation Research
STC	Science & Technology Centers
STTR	Small Business Technology Transfer

Table 3 summarizes the key information gathered during the analysis. In addition to the number of awards and the levels of investment, we were given data on the duration and average annual

funding level for individual awards. The number of active awards (during FY07) is also shown for each program.

Table 3. Data examined by the portfolio analysis, sorted by average annual funding

Program	NSF Funding Level	Est. # Industry Partners	Est. % Industry Support	# Active Awards	# New Awards	Award Duration (yrs)	Ave. Annual Award
ERCs	\$52M		15	20	5	5+5 ¹	\$ 3,000,000
STCs	\$49M	107	5	17	4	5+5 ¹	\$ 2,880,000
NSECs	\$37.5M		5	16		5+5 ¹	\$ 2,300,000
MRSECs	\$54M		20	26		6 ²	\$ 2,075,000
NNIN	\$14M		30	1		5+5 ¹	\$ 1,400,000
NRI	\$2M	6		6	6	3	\$ 350,000
PFI	\$9.2M		10	63	11	2.5	\$ 230,000
STTR (Phases I+II)	\$10M		10	127	127	1+2	\$ 200,000
SBIR (Phases I+II)	\$95M		30	365	365	0.5+2	\$ 175,000
GOALI	\$30M	28	30	43	10	3	\$ 100,000
I/UCRCs	\$8.8M	661	87	52	60	5+5 ¹	\$ 86,000

¹ Initially 5 years, followed by maximum of one 5-year renewal ² May have multiple renewals

Note that the programs vary dramatically in size (from \$2 to \$95M) and fund at a range of award levels and durations. EAC-UIP views this variability as positive, as it offers opportunities for many different types of industry engagement.

The Subcommittee found it helpful to visualize the information in two ways (Figures 4 and 5). The first diagram shows how current NSF partnership programs are distributed at different stages of the supply chain. Horizontal lines have been used to indicate the stages which are covered by each program. A circle is centered on the estimated “center of gravity” for the program (i.e., stage at which most awards are active). Circles have been plotted to represent the relative investment made by NSF (blue circle) and industry (outer ring). As the figure indicates, only the SBIR and STTR programs actually extend as far as commercialization – and even these awards are more likely to be focused on development of proofs-of-concept or testbeds. The I/UCRC program, which has a center-of-gravity at the prototype development stage, should be seen as the farthest along the supply chain.

Figure 6 portrays the information from a different perspective, showing the relative participation of academic institutions, large industry, and small industry in typical awards. Again, the size of the circle is used to denote total funding. This representation reveals that, as might be expected, universities dominate the partnership landscape. Large industry participates primarily through I/UCRC, PFI, GOALI, and NRI programs. Small businesses, for obvious reasons, dominate SBIR/STTR programs; they are also somewhat more likely than large companies to participate in other programs.

We also noted that I/UCRC is currently the only program where the industry investment is larger than NSF’s. Further examination showed that these partnerships have been particularly effective across the board in leveraging NSF’s investment with funding from other sources, including other state and Federal agencies.

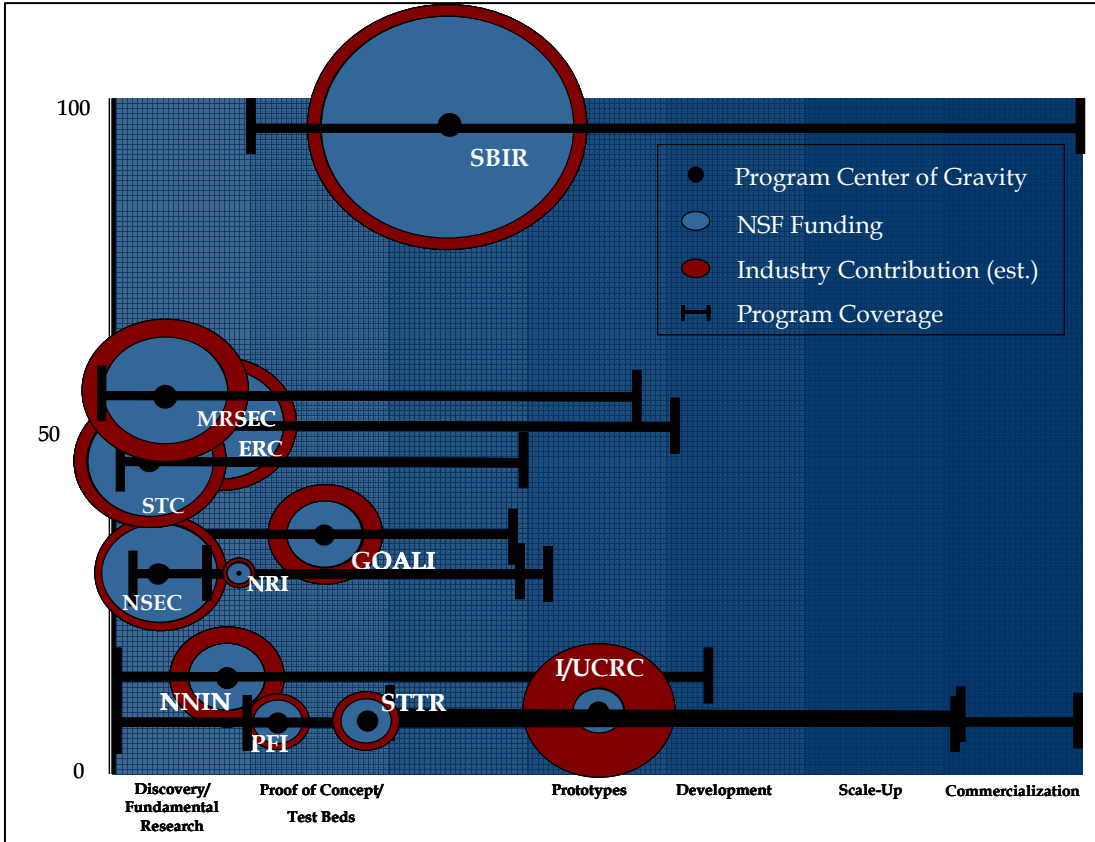
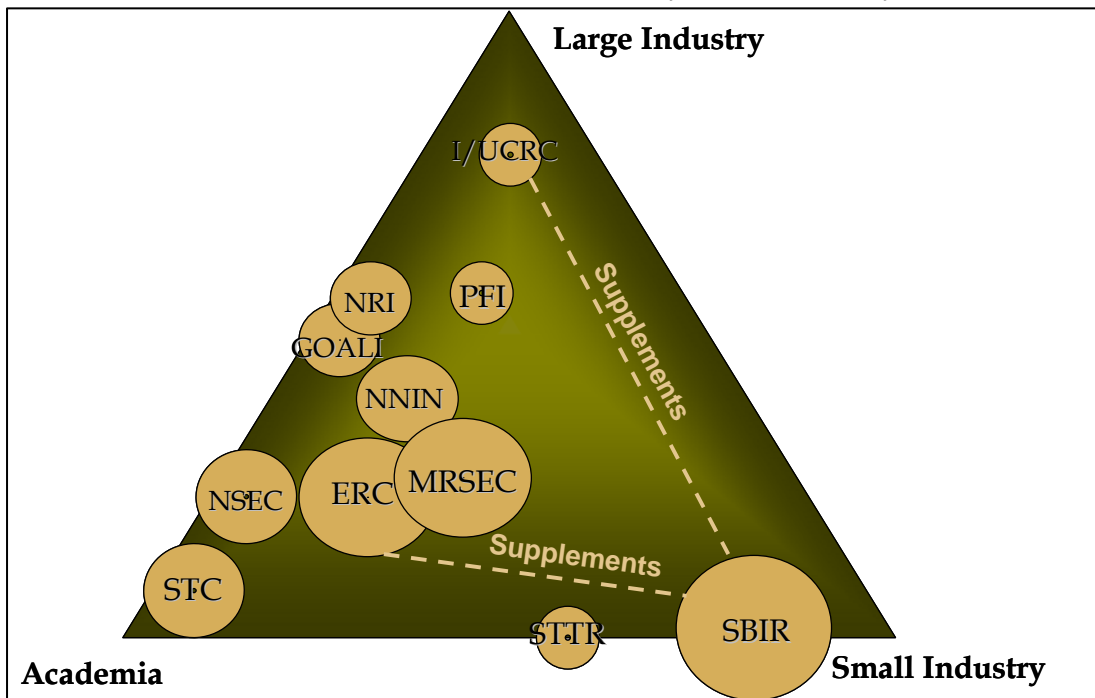


Figure 4. Partnership programs by stage in "supply chain" and total number of awards (size of circle/ring shows relative investment by NSF/industry)

Figure 5. Partnership programs by participant (size of circle reflects total investment by NSF and industry)



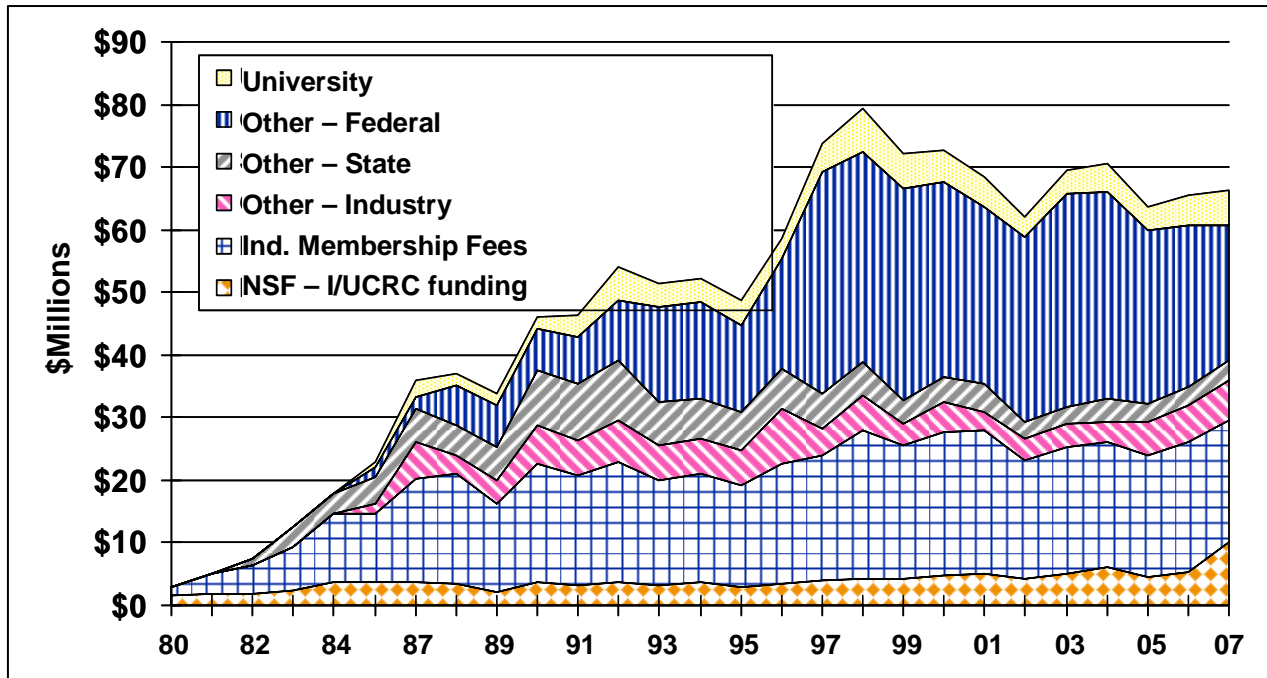


Figure 6. Leveraging of NSF funding in the I/UCRC partnership programming

Finally, Figure 7 views the current portfolio in terms of the “Valley of Death” from Figure 2. The line for each partnership program has been inserted at the point of its center-of-gravity.

3. Review of “Industry Cost-Sharing” Issues

Through the workshop and portfolio analysis activities, EAC-UIP observed that industry participation in NSF-sponsored projects actually includes several types of investment, from hosting academic participants at industry sites to cash and in-kind investments. While clearly related to NSF’s cost-sharing practices (which were repealed by the National Science Board in 2007), the two concepts are not strictly equivalent. Cost-sharing has historically been a requirement for obtaining funding, and as such had to be incorporated as an up-front commitment (part of the original proposal); the support could take the form of dollar investments or in-kind contributions. We found two other types of cash investment involved in university-industry partnerships:

- Fee-based memberships in technology- or application- focused centers
- Supplemental matching funds, whereby NSF matches industry cash investments in ongoing (previously funded) projects

They differ primarily in timing, with membership investment generally initiated at the proposal stage while the supplemental industry investment is added after the program has generated industrial interest.

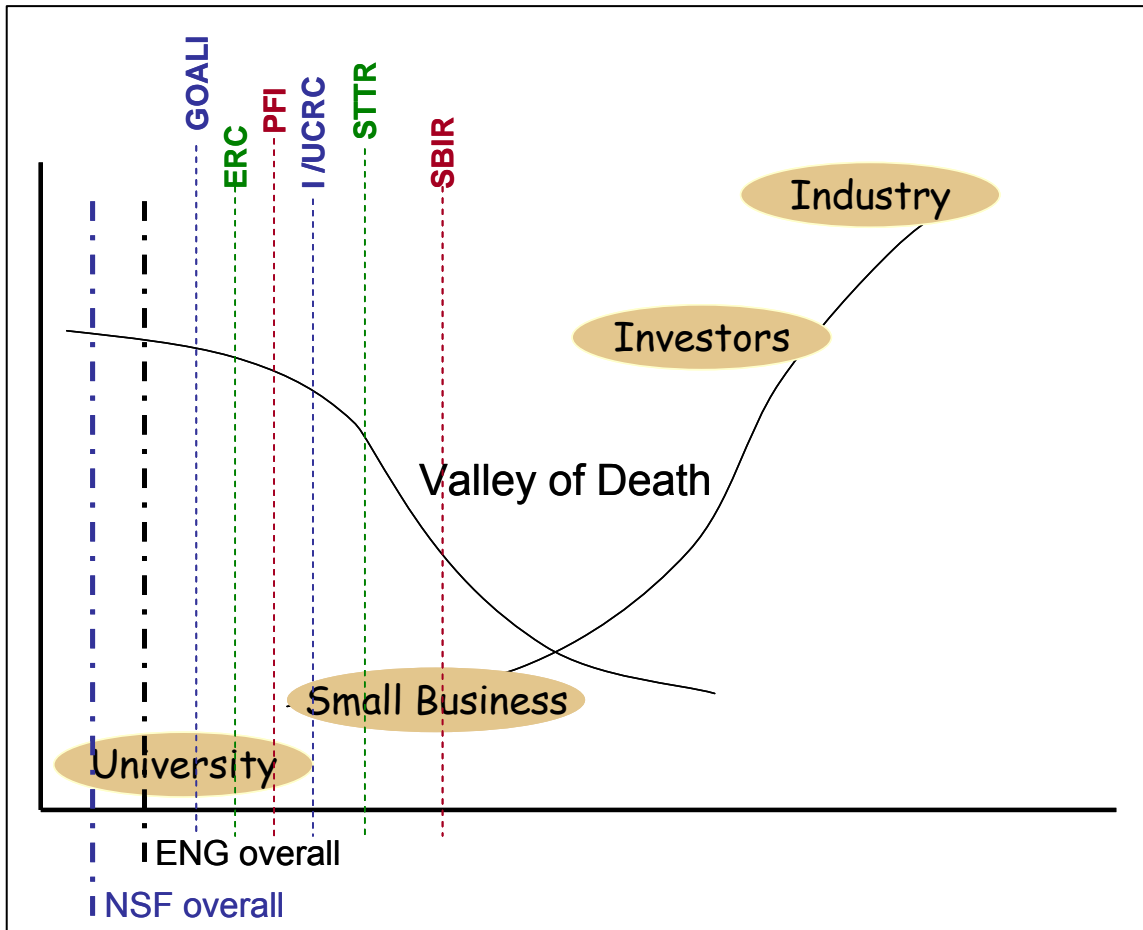


Figure 7. Role of current programs in addressing “valley of death”

EAC-UIP reviewed the two mechanisms and discussed the issues of “cost-sharing” at length. At our November 2007 meeting, we also received briefings on two topics germane to this issue: the America Competes Act of 2007, and initial results from the NSF program on the Science of Science and Innovation Policy.

We found that both the cash investment mechanisms have been effective. Up-front investment by a company (typically through membership in a center) has been very successful, as documented by the Science & Technology Policy Institute’s recent study of best practices among centers-of-excellence programs. Such participation, however, is limited to large-scale projects and requires that the industrial potential be clearly visible from the outset. We believe that it is equally important to offer supplemental funding opportunities, where NSF matches industry dollars, as a mechanism for generating and encouraging industry interest in other types of NSF-funded projects. This view is confirmed by a recent National Academies report on the SBIR/STTR program, which called attention to NSF’s industry-match supplements as an effective “tool for promoting commercialization.” Thus, the sweet-spot for NSF includes both up-front commitments and cost-matching supplements.

Based on these findings, in November 2007 the Subcommittee communicated with a National

Science Board (NSB) group convened to reconsider the elimination of cost-sharing as it relates to industry contributions. We expressed our belief that industry investment is central to the success of industry-university partnership and that promoting such investment – at the level of both large and small companies – is consistent with the American Competitiveness Initiative and the America Competes Act. Some of our points were later included in the NSB report to Congress.

4. Incentivizing Increased Industry Participation

In the process of gathering the information for the workshop and portfolio analysis, the Subcommittee identified key challenges to university-industry research partnerships. While there are clear examples of successful partnerships across the Foundation, we believe that the changing R&D climate and the strategic importance of competitiveness make it particularly important to address perceived barriers to partnership:

- incentives for industry to make cash investments in university-industry partnerships
- industry awareness of how partnership can add value to their own strategic priorities
- faculty awareness of how partnership can benefit their own research
- opportunities for university-industry collaboration that are diverse enough to meet the needs of businesses and universities of all sizes

This section lays out our recommendations for how ENG can respond to these challenges and set a new Foundation standard for leadership in cultivating university-industry partnerships.

4.1. Filling Gaps in the Current Portfolio

The portfolio analysis demonstrated that, while current programs address a variety of positions in the “university-industry landscape,” coverage is not complete. EAC-UIP is particularly concerned that overall, participation must include three types of businesses: large companies, established small businesses, and spinoff small businesses. Moreover, we believe that innovation is greatly increased when connections are forged among these sectors (Figure 8).

Recommendation 1: *We urge ENG to expand existing partnership programs so as to better fill the university-industry landscape.*

Several existing programs are poised more narrowly than they need to be. For example, there is no intrinsic reason why GOALI couldn’t be modified slightly, both to provide more incentives for companies to become engaged and to extend activities to the prototype stage or even beyond. This could serve as a learning arena where academics can be exposed more fully to how industry moves innovations toward commercialization.

Recommendation 2: *We encourage ENG to pilot new partnering programs that address the remaining gaps in the university-industry landscape.*

For example, the Subcommittee believes that it would be beneficial to institute programs that create linkages between the existing SBIR and I/UCRC program, and between SBIR and ERC.

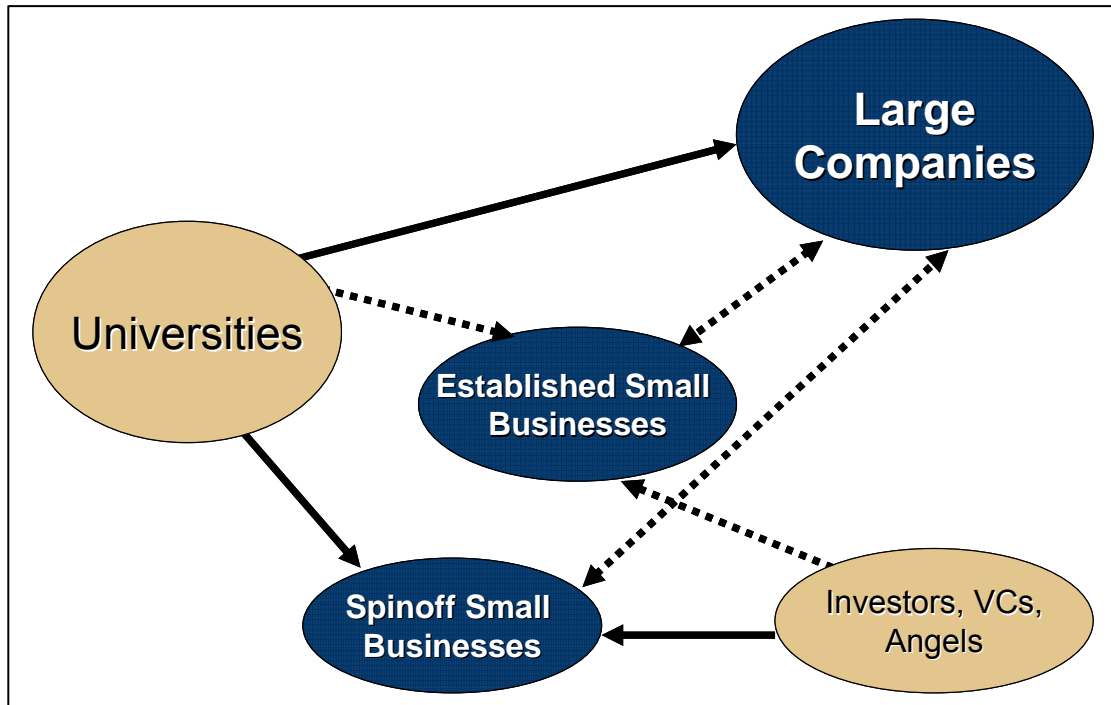


Figure 8. To increase innovation, new connections (dashed lines) must be forged

The first should focus on how to engage small businesses – both established ones and spinoffs – with I/UCRCs, to provide a more balanced industry representation. The second would have the objective of significantly increasing the active participation of industry representatives in academic research activities at the ERCs, thereby expanding the scope of the partnership. Finally, we reiterate that I/UCRC is currently the only program where the industry investment is larger than NSF’s. The next section addresses this point.

4.2. Incentivizing Cash Investments from Industry

As introduced previously, it is clear to EAC-UIP that academic collaborations only become truly meaningful to industry when they are integrated into the company’s strategic processes. Absent this connection, a company is likely to adopt the role of “interested bystander” rather than active research collaborator. The way to ensure that a company will think deeply about partnership – and continue it over the long term – is to involve industry as a cash investor in the collaboration.

This is not to denigrate in-kind contributions, which add leverage to the project and reflect the value of staff time and other material resources provided by companies. There is a clear place for such contributions in many NSF-sponsored research activities. In-kind contributions, however, do not carry the same weight (nor invoke the same paper trail) as monetary investment. Our first recommendation therefore addresses the need to incentivize industry to make cash investments in partnerships.

Recommendation 3: *We encourage ENG to expand its mechanisms to motivate/reward industry financial investment in NSF-sponsored projects, by extending matching-funds supplements to other ENG programs.*

The mechanism currently used by SBIR, which matches some proportion of industry dollars in the form of award supplements, benefits both academic and industry participants and sends a clear message that cast investments are valued. We envision that, like REU supplements, these could be made available to all ENG award recipients. Such a move would encourage academics to become more proactive in seeking out industry partners – and make it possible for more PIs to experience the benefits of working with industry (see Recommendation 3).

The supplement mechanism is actually a powerful one for creating awareness among faculty and university administrators. Consider the impact that REU supplements have had on the inclusion of undergraduate students in funded research. Prior to the general availability of the REU supplements, research teams at many institutions were limited to faculty and graduate students. Although it took some time for the REU mechanism to become generally understood, it is now part of the academic culture. The result is a widespread acceptance that undergraduates need to be introduced to the excitement of research projects, and increasing presence of undergraduates as coauthors on research papers.

4.3. Helping Industry Understand the Advantages of Partnership

One of the most significant barriers to university-industry partnership is a general lack of awareness within the private sector. Many companies are unfamiliar with the benefits of partnerships and wary because of the perceived difficulty of negotiating IP agreements with universities. Others may be interested in the concept of partnership, but unsure how to initiate them and unfamiliar with programs that can help fund academic participation. Three recommendations address those gaps in awareness.

Recommendation 4: *We encourage ENG to continue participating on the National Academies' UIDP, and to do whatever possible to expedite the release of software to assist in negotiating partnership IP.*

The Subcommittee believes that the availability of the proposed “Turbo-negotiator” software will go a long way in alleviating what industry currently perceives as the primary obstacle to collaboration with universities.

Recommendation 5: *We suggest that ENG take a more proactive role in making companies more aware of the benefits of investing and participating in NSF-sponsored research projects.*

Many companies do not understand the role of universities in the innovation supply chain, and therefore are not “partnership-ready.” ENG has decades of experience in observing partnerships and should take a leadership role by developing outreach materials that are self-explanatory and focus on benefits to industry. Two or three brief case studies (drawn from NSF examples or based on UIDP’s “living studies”) could go a long way in meeting this critical need, if cast in terms of using federally-funded efforts to leverage a company’s own investment in strategic research topics. The materials should thus distinguish between industry-funded research per se, and industry picking up on research funded by NSF and agencies. They should provide “testimonials” from companies about how GOALI, I/UCRC, SBIR, ERC, etc. allowed the university and the company to “each do what they do best” and thereby accelerated progress for both.

EAC-UIP endorses the planned Foundation-wide workshop on “Advancing the Scientific Study of Innovation—Discovery Cycle Partnerships” as a potentially valuable step in this process. The ENG participants may be able to glean valuable additional examples from these discussions.

Recommendation 6: *We urge ENG to mount an awareness campaign with the goal of helping companies understand NSF’s partnership programs.*

Even within NSF, there is sometimes confusion about the extent to which different programs encourage or fund partnerships. Many companies remain entirely unaware of the role NSF plays in sponsoring collaborative research. Creating a clear “industry-university worksheet” that guides companies to the programs most relevant to their needs – and disseminating through groups like the UIDP, the Kauffman Foundation, and industry participants in NSF advisory groups, panels, and committees of visitors – would go a long way toward increasing awareness. It will be important to distinguish between two types of partnership. Direct-investment partnerships put a company in the position of setting research agendas and having the first option on results. Membership-based partnerships are less directly involved in day-to-day academic research, but enable companies to influence research directions and gain access to the expertise of academics.

4.4. Helping Academics Understand the Advantages of Partnership

The Subcommittee believes that academics, too, are generally unaware of the benefits of partnering with industry, as well as the mechanisms for doing so. We also believe that NSF is in a unique position, based on its funding role and unassailable reputation, to get the attention of faculty and university administrators alike. We offer two recommendations, which are analogous to those of the preceding section but specifically address the gaps in academic understanding of industry-university partnerships.

Recommendation 7: *We encourage ENG to take a proactive role in making faculty aware of the benefits of seeking and participating in partnerships with industry.*

NSF has much more of an influence on faculty behavior than is generally realized. The extremely competitive environment for research funding means that faculty heed information about opportunities for obtaining new sources of funding. As in recommendation #3, we suggest that outreach materials be prepared specifically for this audience. (Note that if Recommendation 1 is put into effect, ENG can use the supplement mechanism as an impetus for the awareness campaign targeted at faculty.) The case studies – which, again, could be drawn from NSF examples or based on UIDP’s “living studies” – should emphasize how partnerships increase the relevance of academic research to real-world needs and help faculty see where some of the hardest problems lie, as well as providing mechanism for leveraging federal or state funding. The materials should provide “testimonials” from academics about how GOALI, I/UCRC, ERC, etc. allowed the university and the company to “each do what they do best” and thereby accelerated progress for both. The goal is to educate faculty to understand and recognize market opportunities.

Recommendation 8: *We urge ENG to mount an awareness campaign with the goal of helping university administrators and faculty understand NSF’s partnership programs.*

In some cases, university administrators and faculty have even more misconceptions about partnership than industry representatives. There is a widespread belief that working with industry

“diverts” faculty from the kinds of research accomplishments that are needed to achieve tenure. EAC-UIP believes that many faculty are missing out on significant opportunities because of this misunderstanding. This is exacerbated by general lack of awareness of the breadth of partnership opportunities available through NSF. As in Recommendation #4, we urge ENG to create a “university-industry worksheet” – this time targeted specifically to academics – that clarifies the different partnership mechanisms and how each program helps academics exploit opportunities for industry interactions.

4.5. Diversifying Opportunities for University-Industry Partnership

In reviewing the current partnership programs available through NSF and discussing their impact on technology transfer, it became clear to EAC-UIP that there is no single model for industry involvement that applies equally well to large and small businesses, partnering with all types of academic institutions. The Subcommittee believes that it is in everyone’s interest to maintain a diverse portfolio of programs supporting partnerships. We therefore make two final recommendations.

Recommendation 9: We urge ENG to champion, within NSF, the need to offer many different types of university-industry partnership mechanisms – and to encourage the broader adoption of partnership mechanisms so that they are available to a much wider cross-section of faculty researchers.

The Subcommittee’s recommendation to the National Science Board reflected our concern that opportunities for obtaining NSF funds in support of partnership should not be narrowed (as occurred as a side effect of last year’s elimination of cost-sharing), but rather broadened. We suggested that rather than eliminating industry cost-sharing, it should be made even more flexible: “Programs should be allowed to require industry dollar investments as a mechanism for encouraging and sustaining industry/university partnerships for research and education. Major programs, in particular, should be permitted to stipulate that industry contribute a proportion of the proposed budget, but the threshold for participation must be flexible and take into account the nature of the activity and variations in the size and capabilities of both companies and academic institutions. All programs should be given the latitude to provide supplements that match industry investment at some proportional level.”

ENG is the appropriate Directorate to champion Foundation investment in university-industry partnerships. It manages the Foundation’s largest, and undisputably successful, research program affecting industry (SBIR/STTR), hosts a centers program that is founded on university-industry partnerships (ERC), and is closely involved in most other partnership programs Foundation-wide. Moreover, the profession of engineering is intimately tied to how fundamental discoveries can be transformed into practice. Hence the Subcommittee believes that it is clearly ENG’s role to serve as vocal and proactive champion for all kinds of university-industry partnerships.

Recommendation 10: We suggest that ENG continue monitoring the progress of all university-industry partnership mechanisms, Foundation-wide, and periodically re-assess them to ensure that the number and type of opportunities meet the diverse needs of academic and industry constituencies.

As the business climate continues to evolve, there may be a need to institute new types of partnerships or to eliminate mechanisms that are no longer effective. It might be desirable to develop new mechanisms targeting particular communities or responding to emerging “gaps” in the innovation supply chain; e.g., to create new roles for venture capital backed startups in order to promote risk taking or different types of technology/IP positioning, or new types of collaborative projects that binds companies to a multi-year commitment. We also encourage ENG to continue monitoring related programs at other Federal agencies and at foundations. This could also lead to new opportunities where NSF can partner with other groups to sponsor new types of university-industry collaborations.

5. Summary

The Engineering Advisory Committee’s Subcommittee on Industry-University Partnerships (EAC-UIP) was convened in the Spring of 2007. The group first conducted a workshop to study the landscape of partnership programs at NSF (plus DARPA and NASA) and identify best practices. This was followed by an analysis of NSF’s current portfolio of partnership programs, which examined funding levels, the relative roles of small and large industry, and where partnerships fit along the “innovation supply chain” (discovery-to-commercialization process). We also reviewed the National Science Board’s decision to discontinue industry cost-sharing as part of a larger moratorium on cost-sharing, and submitted a recommendation to them that industry investment be reinstated by the Foundation.

All members of the Subcommittee believe that industry investment in NSF-funded research is of long-term strategic importance and should be encouraged. Requiring or endorsing industry contributions helps incentivize academics to form partnerships outside the academic environment. It also sends an important message to the public about the project’s relevance – and that industry and government are both vested in R&D.

Our discussions identified several issues that make university-industry partnerships challenging. From these, the Subcommittee formulated the following recommendations to the Engineering Director:

- 1. Expand existing partnership programs so as to better fill the university-industry landscape.**
- 2. Pilot new partnering programs that address the remaining gaps in the university-industry landscape.**
- 3. Expand mechanisms to motivate/reward industry financial investment in NSF-sponsored projects, by extending matching-funds supplements to other ENG programs.**
- 4. Continue participating on the National Academies’ UIDP, and do whatever possible to expedite the release of software to assist in negotiating partnership IP.**
- 5. Take a more proactive role in making companies more aware of the benefits of investing and participating in NSF-sponsored research projects.**

6. Mount an awareness campaign with the goal of helping companies understand NSF's partnership programs.
7. Take a proactive role in making faculty aware of the benefits of seeking and participating in partnerships with industry.
8. Mount an awareness campaign with the goal of helping university administrators and faculty understand NSF's partnership programs.
9. Champion, within NSF, the need to offer many different types of university-industry partnership mechanisms – and encourage the broader adoption of partnership mechanisms so that they are available to a much wider cross-section of faculty researchers.
10. Continue monitoring the progress of all university-industry partnership mechanisms, Foundation-wide, and periodically re-assess them to ensure that the number and type of opportunities meet the diverse needs of academic and industry constituencies.