In this final chapter, we summarize the main conclusions of the workshop regarding the evaluation of the PFI program and identify major issues related to the NSF’s role in the innovation process. We close with our own observations regarding the sorts of questions that the NSF should seek to address as it adapts itself to the changing needs of the nation in the new century.

EVALUATING THE PFI PROGRAM

Chapters Three and Four identified a large number of suggested measures related to various issues attendant to innovation and partnerships. We now step back from these details to summarize the arguments related to the broader question of evaluating the PFI program.

There was nearly unanimous support for a formal evaluation of the PFI program by an independent, paid evaluator. Such an effort was viewed as being consistent both with the NSF’s general commitment to evaluation as an aid to outcome-based management and with its specific obligations under the Government Performance and Results Act of 1993 (GPRA).¹

According to participants, such an evaluation should rely on objective measures that can lead to insights regarding the most critical questions related to innovation and the partnerships themselves. It

¹The text of the act may be found at http://www.nsf.gov/od/gpra/law.htm.
also should provide outcome and process measures (or, as used in this report, signposts) both for individual projects and for the program as a whole. Although PIs should be consulted in the development of evaluation metrics—and should assist in identifying which are appropriate for their partnership—an outside evaluator was viewed as necessary to ensure objectivity and impartiality in the evaluation.

As described above, an evaluation of the PFI program also should leverage off lessons learned and best practices from the many other NSF programs that promote innovation and link universities and industry. Moreover, many argued that the NSF should use the opportunity of an evaluation to turn the lens back on itself: To inform further refinements of the PFI program, the evaluation should include measures of the quality of the technical and other assistance the NSF is providing to PFI partnerships, the extent to which that support helped the partnerships, and what other assistance also might be made available.

Although some seemed to imply that there was something of a sense of urgency on the matter of an evaluation—e.g., that data that would be needed for an evaluation might not be collected or might become lost—others seemed to argue that since actual outcomes could not be known for several years at the very earliest, this was not a particularly urgent matter. In either case, however, the basic need for a proper evaluation of the PFI program was generally accepted.

**THE NSF’S ROLES IN INNOVATION**

As described in the preceding chapters, beyond its traditional roles of promoting the public good by supporting research and education, the NSF was seen by participants to have a number of critical roles, including catalyzing change, forging connections, enhancing institutions, establishing standards and identifying best practices, enhancing diversity, and nurturing alternative models. Each will be summarized next.

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2See Appendix G, which summarizes workshop discussions regarding both some design principles and the potential challenges in such an evaluation.
Catalyzing Change

The NSF has a unique ability to lead in catalyzing needed institutional changes in the university. This can be accomplished by providing an NSF stamp of approval for university researchers working with industry and developing ranking criteria, awards and other reward systems, and other incentives that can foster needed cultural changes in universities and lead to greater university support for the application of research.

Enhancing Institutions

One means for catalyzing change is creating incentives for the development of institutional capacity for innovation. This can include seeding the creation of multidisciplinary or industry-oriented university-based centers of excellence and assisting existing centers in fostering capacity to meet industry needs.

Forging Connections

The NSF has an important role to play in improving the performance of the information markets that make innovation possible. This can be accomplished by sponsoring meetings and other mechanisms that heighten the prospects that interested and potentially complementary parties will become aware of one another, supporting the development of networks of various kinds (e.g., alliances, LISTSERVs with threaded discussions), and other means.

Establishing Standards and Identifying Best Practices

The NSF also can serve as an honest broker in developing relevant standards and metrics, identifying lessons learned and best practices, and ensuring their widest possible dissemination. Leadership in the development of appropriate standards and metrics is needed—particularly for some of the harder-to-measure aspects of innovation and partnerships—since it is generally beyond the capacity of individual partnerships to establish a consistent framework
themselves.\(^3\) The NSF’s diverse portfolio of programs that focus on innovation and fostering university-industry linkages also gives it a unique capacity to compile and disseminate lessons learned and best practices from these many programs, both among principal investigators and among broader constituencies.\(^4\) The NSF also can sponsor conferences of awardees who meet more regularly to share insights, as well as supporting other means of enhancing communication and learning.

**Nurturing Alternative Models**

An apparent consensus in the workshop was that innovation functionally required sufficiently frequent and routine interactions between researchers and industry to develop the necessary levels of mutual understanding and trust that could lead to fruitful partnerships. This in turn required stable infrastructure that could provide both a reliable place for these interactions and operational support.

Less explicitly, it was clear from the workshop that participants believed that a range of alternative models was available for incubating and otherwise supporting innovative partnerships, networks, and other arrangements and that each of these alternative models deserves support: S&T parks and campuses, incubators and accelerators, centers of excellence, ERCs and I/UCRCs, and other settings (see the box, below).

Indeed, workshop participants seemed to endorse both an expansion in the NSF’s support for innovation and partnerships through the PFI and continued efforts by the NSF to further diversify its programmatic support for innovation. The presentations and workshop discussions evidenced substantial enthusiasm for the PFI program and other NSF programs that support innovation and university-industry collaborative efforts, without favoring any particular model (e.g., PFI) over any other (e.g., I/UCRCs).\(^5\)

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\(^3\)For additional reading, see Norling (1997).

\(^4\)For example, some suggested that the NSF might arrange for speakers from the I/UCRC program, and their evaluators, to provide their insights on evaluation.

\(^5\)It is worth pointing out that a number of workshop attendees were neither grantees nor had any intention of applying for a PFI grant.
An Infrastructure Model for Innovation

There is a range of models available for supporting innovative partnerships, networks, and other arrangements. Marye Anne Fox described one such model being used at North Carolina State University.

NC State’s Centennial Campus provides physical infrastructure that allows members of academe and industry to come together for the integration of industry activities into academic programs, and brings together workforce, ideas, new approaches to education, and technology transfer on a single campus. Centennial Campus is a carefully planned community designed to foster innovation and support a unique culture of partnerships that bring ideas, people, and technology together in new ways. It is unique in comparison to other types of research parks, in that it looks for partnerships; ways for industry or government partners to enhance university academic and educational programs while concurrently bringing value to what they do.

The goals of the Centennial Campus have been to break down some of the disciplinary structures that have been developed at the university over the last few years, and also to expand the results to industry. The campus plan centers around its R&D neighborhoods, which are each dedicated to a subject area and house one or more related core university programs. Buildings with space for R&D facilities are available for select businesses and government agencies whose operations relate to these program areas. The million square feet of physical space on the campus has been generated by investments from the state, private sector, and from government. On campus, there are 53 companies (16 large, 10 small, and 27 startups), seven government agencies, seven nonprofit companies, and 23 R&D centers, primarily funded by the state. 900 employees from the private sector, 900 faculty, staff and post-docs, and 1,400 students are involved in the Campus. Creation of this technology infrastructure permits NC State’s students to make non-traditional connections with industry and government.

The Centennial Campus is just one model available for supporting and sustaining innovation. Other models include traditional S&T parks and campuses; incubators and accelerators; centers of excellence; ERCs and I/UCRCs; and other settings.

Fox (2001).
The workshop devoted less attention to the topic of selection criteria and the difficulties of identifying for support only those enterprises that would not ordinarily be supported by industry.\(^6\)

LOOKING TO THE FUTURE

In closing, we now shift from one role—faithful reporters of the workshop proceedings—to another—policy analysts and advisors to the NSF and the PFI program.

As the NSF takes stock of its past experience and reflects on how it will express its future commitment to catalyzing innovation, we believe that it should ask itself a number of questions, strategic in nature, to illuminate the benefits and costs associated with different paths. Among these are the following:

- Which of the available programs and models for promoting innovation is the most appropriate tool for the NSF to use under which circumstances?
- How can the NSF refine its understanding of the relative effectiveness of its innovation programs in promoting its objectives?
- In what ways can the NSF exploit synergies between programs (e.g., PFI programs that are incubated in an ERC or I/UCRC)?
- In what ways can (or should) this mosaic of programs and models be considered together as a larger whole to ensure that the NSF’s enterprise-wide portfolio of innovation-catalyzing programs matches its strategic intent and its presumed desire to achieve an optimal program mix and level of diversification?
- What is the best balance or tradeoff among the various potentially conflicting imperatives (e.g., education and workforce development, academic research, innovation, and diversity)?

\(^6\)For example, one would want to make sure that the NSF funds do not “crowd out” private funding. On this issue, see Wallsten (2000), and David and Hall, (2000).
• What factors are associated with the success or failure of technology partnerships, networks, and clusters?7

Insofar as these questions seems to be at the heart of the NSF’s effort to build a new foundation for innovation while remaining true to its purpose, they seem particularly deserving of further analysis, discussion, and debate.

7On technology clusters, see, for example, Porter (1990), Sternberg (1990), Saxenian (1996), BankBoston Economics Department (1997), Malecki (1997), Luger (1999), and Schmandt (1999).