SUMMARY

Demonstration projects have become increasingly popular as innovative responses to a broad spectrum of national problems. Federal expenditures for demonstration projects, including social program demonstrations, have grown to over $1 billion annually, and further growth appears likely. Yet their effectiveness has been limited.

Demonstrations are frequently used in areas, such as energy, where there is controversy concerning what constitutes desirable and timely innovations. To effectively evaluate proposed and ongoing demonstrations in such areas, Congress must be able to develop a set of realistic expectations for a demonstration's outcome. In order to provide this capability, the present report develops:

- A perspective that permits analysis of demonstrations in many policy contexts; and
- Guidelines to aid the evaluation of individual proposals for demonstration projects.

The perspective and guidelines are derived from analyzing the lessons learned in both social and hardware demonstrations.

Perspective

The perspective developed here encompasses both the different purposes of demonstration projects and the principal factors that determine success.

What is a Demonstration?

The term "demonstration" is ambiguous. It can mean to test an innovation for the purpose of formulating national policy. Or, it can mean to show others the relative advantage of an innovation for the purpose of persuading them to use it. We define a demonstration here as:

> A project in which an innovation is operated at or near full scale in a realistic environment in order to (1) formulate national policy, and/or (2) promote the use of an innovation.

The term "innovation" may refer to a new program, product, or process.

Policy-Formulating Demonstrations

We refer to the first type of demonstration project as a ***policy-formulating demonstration.*** Federal decisionmakers are its principal audience. The income maintenance experiments that examine the administrative feasibility, costs, and impacts of a variety of income transfer programs provide an example of this type of demonstration. Demonstrations that provide the necessary technical or economic information for setting regulations and standards are also a type of policy-formulating demonstration. The Refan program to reduce noise from commercial jet aircraft and inform regulatory decisions of the Federal Aviation Administration is an example. Typically, policy-formulating demonstrations are intended to provide information to Federal decisionmakers about:

- Technological and administrative feasibility of instituting a policy or adopting an innovation.
- Expected economic, environmental, and social impacts of the policy or innovation.

Policy-Implementing Demonstrations

We refer to demonstrations to promote the use of an innovation as ***policy-implementing demonstrations.*** Solar heating demonstrations are an example. The criterion of success for this type of demonstration is diffusion of the innovation from the demonstration site. Thus, those non-Federal decisionmakers who control the rate of diffusion of an innovation are the principal audience for these demonstrations. In addition to the factors mentioned above for policy-formulating demonstrations, policy-implementing demonstrations are typically intended to provide information on:

- Costs of adopting and using the innovation.
- Reliability of that innovation in use.
- Demand for the innovation.
- Feasibility of implementing the innovation at the adopter's site.

The common denominator of both types of demonstrations is the generation of information for decisionmaking, and a single project may in-

corporate elements of both types of demonstrations.

Who Expects What From a Demonstration?

Demonstrations often serve important political as well as information functions, such as providing:

- A compromise between those who prefer a large-scale operating program and those who prefer nothing.
- A means of expressing concern for a national problem.
- A response by executive agencies to pressures to show the usefulness of their R&D program.

Furthermore, because demonstration projects are an instrument of transition from R&D to use, an innovation may be simultaneously moving:

FROM	TO
Small scale in the laboratory . .	Full scale in the field;
Control by R&D personnel . . .	Control by operating personnel;
Technical criteria of success. .	Institutional criteria of success;
Federal management	Private sector management or State and local management.

The range of different but limited perspectives involved makes a transition such as this difficult to bring about and complicates the evaluation of proposed demonstrations.

All of these factors imply that various interested parties often have different objectives and expectations from a demonstration project. Some may view it primarily as a test of an innovation; others may view it as a promotion of an innovation; still others may view it primarily as a means of expressing concern for a national problem.

These different objectives and expectations make the evaluation of a demonstration difficult and necessarily judgmental. Nonetheless, such judgments can be informed by realistic expectations of a demonstration's outcome.

Institutional Environment, Technology, and Success

There are two essential requirements for a successful demonstration project: (1) clearly specifying the relevant information to be generated, and (2) generating reliable information once specified. The specification of the relevant information depends largely on the ***institutional environment;*** reliability of the information generated depends largely on the ***technology*** (pp. 22-27).

An institutional environment is characterized by the users of an innovation, its suppliers, markets, and regulators of those markets. A well-developed institutional environment has two characteristics—a tradition of using the results of R&D, and an accepted Federal role. In such an environment there is generally consensus among the various participants as to what constitutes a desirable innovation and when a demonstration is appropriate. An example of such a well-developed institutional environment is the agricultural sector with its system of experiment stations, land-grant colleges, and extension agents. Conversely, the components of the institutional environment in the elementary and secondary education system are unevenly developed, poorly linked, and frequently in disagreement over the process of change in the schools. In the public sector, there is often a lack of consensus—and even fundamental value and goal conflicts—regarding the desirability of innovations. In the private sector, the discipline of the marketplace tends to force a greater degree of consensus as to what constitutes a desirable innovation.

The term "technology" refers here to knowledge for the production and delivery of goods and services. Some technologies, such as central-station electric power generation, are well developed, with well-characterized inputs and outputs and a good understanding of their relationship; other technologies are poorly developed, as in education and law enforcement. Demonstrations employing poorly developed technologies are less likely to be perceived as generating reproducible results than those employing well-developed technologies.

The Federal role in a given policy sector determines the scope of the Federal R&D effort in that sector, and consequently, the role of demonstrations (pp. 9-15). In many areas of domestic policy a major Federal role is relatively new and often controversial. In areas where the Federal role is still controversial, and it is difficult either to reach consensus as to relevant outcomes or to

generate reliable information, the effectiveness and role of demonstrations remain to be clearly determined. The experience in agriculture suggests that an extended period of time is required for an effective and accepted Federal role to be established.

Guidelines for Evaluating Proposed Demonstration Projects

The following questions focus attention on key factors that influence success in demonstration projects (pp. 31-41). The brief discussions attempt to provide the necessary perspective by which one can evaluate critically the answers to these questions.

1. Are the goals for a demonstration project clearly articulated and agreed upon?

A divergence of goals and expectations among funders, performers, and potential audiences may often be inevitable. Nonetheless, to avoid an inadvertent lack of clarity in goals, an effort should be made to ensure that program managers and performers of demonstrations share a common understanding of the purposes of demonstrations. Specifying how the results of a demonstration are to be evaluated can be an effective device for clarifying goals.

2. Given the purposes of a demonstration project, 'have the information needs of the demonstration's audience been adequately considered?

A demonstration may be intended to inform a congressional debate on a welfare system. Or, a demonstration may be intended to promote the commercialization of a new energy technology. In either case, the demonstration should be designed to address the critical issues upon which the decisions will turn, as perceived by the relevant decisionmakers themselves.

This assumes, of course, that the necessary decisions can be effectively informed by a demonstration. For example, policy-implementing demonstrations by themselves have been weak means for bringing about institutional change. In such cases, other measures, where available, should be considered as alternatives or complements to demonstration projects (pp. 48-51) .

3. If the demonstration is intended to promote the diffusion of an innovation, have key actors in the institutional environment been involved?

It is not only important that an institutional environment be sufficiently well developed to generate a consensus on the criteria for successful innovations. Diffusion of an innovation is also enhanced by the actual involvement of an institutional environment's key actors in the planning of a policy-implementing demonstration.

An illustrative example is provided by a demonstration of mechanized refuse collection aimed at reducing labor costs through smaller collection crews. The mechanism was designed by city personnel, but no garbage truck outfitting firm was involved in the demonstration. Despite striking success at the demonstration site, no commercial firm could be found to market the innovation, and there has consequently been little diffusion.

4. Is the technology incorporated in a demonstration sufficiently reproducible to be credible?

Projects incorporating poorly developed technologies seldom lead to similar operations in other locations. For example in education, significant innovation appears to occur at a site only when there are major adaptations in the innovation to meet local needs. The apparent requirement for a unique implementation of an innovation at each potential adoption site tends to preclude its replication elsewhere.

Support for local problem-solving efforts where diffusion is not a relevant success criterion might be better termed "subsidized local development" than a demonstration project. Although few such efforts have survived withdrawal of the Federal subsidy, such support might still be useful where a genuine commitment to address real problems can be distinguished from mere opportunism in response to available funds.

Extensive adaptation of an innovation to meet specific local needs may also occur where technologies of substantial reproducibility are used in a larger "system ." Examples include mass

transit, law enforcement hardware, and mining. For technologies of low to intermediate reproducibility, successful replication at multiple sites may be necessary to stimulate diffusion.

5. Is the technology being demonstrated well in hand?

Even though a technology may be potentially reproducible with great reliability, its development may not have proceeded to the point where it is well in hand. There is persuasive evidence that attempts to demonstrate a technology that is not well in hand adversely affect diffusion.

For example, extensive development work was required during the demonstration of a desalination process in Freeport, Tex. Although this work led to important improvements in performance, it also caused interruptions in plant operations. Potential adopters of desalination plants mistakenly perceived these interruptions as an indication that the desalination process was unreliable, and there has been no diffusion.

This example illustrates the importance of considering the alternative of a full-scale test at a testbed facility when a technology is not yet well in hand. Such testing would avoid both conveying the adverse impression of unreliability to potential adopters and facilitate engineering solutions to technical problems by removing real-world operating constraints.

6. Is there sufficient time and operational flexibility for the demonstration to meet its objectives?

Strict time constraints generated by policy or political needs have seriously impaired demonstrations from achieving diffusion success. , operational flexibility is essential for coping with unanticipated difficulties that fre** appear in such projects.

7. Is there sufficient evidence of commitment to the innovation by the performer?

Cost sharing and initiative by non-Federal participants in a policy-implementing demonstration provide an important test of user need. It maybe difficult to distinguish opportunism as a response to available funds from a commitment to address real problems without a significant measure of cost sharing.

Failure of the private sector to assume a substantial portion of the costs and risks is itself informative, and may indicate the technological, market, institutional, or environmental uncertainties are too high. A demonstration would then be premature without prior steps to reduce such uncertainty.

Alternatively, the innovation may simply be uneconomic. Failure to commercialize would then have nothing to do with the lack of knowledge that could be produced by a demonstration project. In such a case, policies that change the incentive structure facing the potential innovator should be considered as an alternative to a demonstration project, or the commercialization effort should be delayed until further R&D or changed economic conditions make it more attractive.

8. Does the design of the demonstration project reflect the experiences of past demonstrate ions?

Any well-conceived and well-executed demonstration project strives to reduce uncertainty in the various dimensions of a problem. However, the failure of a demonstration may highlight dimensions of a problem whose significance was not adequately appreciated. The insights gained can be used to reformulate national policy or be incorporated into the design of future demonstrations.

For example, at the time of the Atomic Energy Commission's first power reactor demonstrations, electric utilities could not obtain liability insurance against nuclear accidents. The recognition of **this** barrier to the diffusion of nuclear power led to passage of the Price-Anderson Act which imposed a legal limit on damages that

could be claimed after a nuclear accident. By creating a more favorable institutional environment, further demonstrations were able to succeed in promoting the diffusion of nuclear power. Further demonstrations by themselves, however, would have been unable to overcome this barrier which had nothing to do with the lack of information that could be produced by a demonstration project.

Conclusion

Despite their obvious potential, demonstrations can be easily misused. The perspective and guidelines developed here are to help Congress more effectively utilize this important policy instrument for pursuing national goals.