Chapter V
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In this chapter we review the reasons that the Federal Government may choose to use demonstration projects to promote the use of innovations. These reasons, together with the analysis presented in the previous sections, suggest several implications for Congress. Because demonstrations are not a uniformly attractive policy instrument, we briefly review a number of alternative policies for promoting the use of innovations. We conclude with some questions to be examined in a congressional review of demonstration projects.

Reasons for Use of Demonstrations Projects

The most important implication of the previous chapters is that demonstrations, as *a component of the R&D process,* have a relatively narrow scope of usefulness. For ***policy-implementing*** demonstrations, the analysis and evidence suggest that desirable features for success are a reproducible technology and one that is "well in hand, " together with a well-developed institutional environment whose members are involved with the demonstration. Technologies with low reproducibility or fragmented and undeveloped institutional environments of the types associated with many domestic programs seem unpromising areas for the use of demonstrations.

The situation is less clear for ***policy-formulating*** demonstrations because the criteria for success of such demonstrations are less well-defined and the experience, less extensive. They typically are expensive activities relative to the R&D that precedes them. On the other hand, they may be inexpensive relative to the costs (and risks) of a full-scale initiative.

The Demonstration Project as a Political Tool

In contrast to their limited usefulness in the R&D framework, demonstrations are considered by many to be politically attractive. Demonstrations permit modestly priced responses to emerging political problems; they are, in a sense, a means of symbolic action. Demonstration projects can show constituents that Washington is doing something for them. Demonstrations may be a means of delaying policy decisions while additional information—both technical and political—is accumulated. Demonstrations are a convenient point of compromise between those who would do much and those who would do little.

The Absence of Alternatives to Demonstration Projects

Not only are demonstrations politically attractive but in many instances there appear to be few feasible policy alternatives. If Congress presses R&D funding agencies to promote the application of the results of their efforts, and the agencies are restricted to project grants (rather than to changes in tax codes or widespread subsidy programs), demonstration projects, along with information dissemination systems, are about the only tools available. If decisions concerning regulatory policies—say defining an acceptable level of effluents—will not be made in the absence of a specific case that forces such a determination, a demonstration project may be the only way to force the decision. Because the traditional distribution of responsibilities between Federal, State, and local government generally precludes the direct intervention of the Federal Goverment in local affairs, the demonstration project may be the most attractive available tool for trying to persuade the State or local communities of the importance of the national goal. Increases in regulated prices or changes in the tax codes to make private-sector innovation more profitable may be perceived as placing socially unacceptable burdens on groups such as the poor; demonstration projects are a possible substitute. Thus, while the prospects for success with a demonstration project may not be good, the demonstration may be the best policy instrument available; and in some in-

stances, the importance of the problem may dictate its use.

The Demonstration as an Instrument of Transition: Inherent Difficulties

These qualities of demonstrations pose difficulties for Congress as it performs its legislative functions. Moreover, the role of demonstration projects as instruments of transition means that Congress must proceed in the face of poor and probably biased information. Ideas imbedded in the project are moving from R&D to use; technical criteria are being supplanted by institutional criteria of success. Projects are evolving from the small scale typical of a laboratory to full scale in the field. Control is shifting from R&D personnel to operating personnel. In many instances, this transition is associated with a movement from public to private-sector sponsorship and management. Alternatively, the innovation may shift from Federal emphasis and sponsorship to State and local use. Not only is a transition such as this difficult to bring about, but it gives rise to strong advocacy by individuals and groups with a stake in the innovation.

R&D personnel who have developed a new technology often wish to proceed to the next logical step, a demonstration in the field. Industry, particularly that part associated with earlier development work, may seek a subsidy for continuation into the demonstration phase. Final users such as State and local officials may well see the innovation as a means for enlarged political power or career advancement. Because of the transitional nature of the demonstration, however, most actors have only limited perspectives concerning the worth of the innovation.

The developer may not be aware of all the institutional impediments to the application of the innovation. The final users may have insufficient understanding of the nature of the technology and may have a large personal stake in its application. The industrial firm may see the opportunity to obtain a subsidy for an effort that it might otherwise have to fund itself. In any case, Congress or the senior executive branch officials will be faced with conflicting information.

Incentives for Government Agencies to Use Demonstrations

When considering policies to promote the commercialization of new technologies by the private sector, Congress should take particular note of the nature of the incentives that govern the behavior of Federal R&D agencies. These agencies are under continual pressure from the public and Congress to show that their programs have resulted in technologies and knowledge that are being used. One of the most straightforward means of obtaining an example of use is to create a demonstration project. A demonstration project may thus be viewed as a simple means of placating critics rather than as a component of a well-developed strategy to promote the use of the results of an R&D program.

Even in public bureaucracies where there is a thoughtful policy for promoting the use of technology, there are some undesirable incentives. As we have noted, it is the reality of the R&D process that there is both uncertainty concerning the worth of an idea that is being developed and a likely division of opinion about the most likely outcome of its application. This should result in dropping or sharply redirecting a substantial proportion of R&D efforts before they reach fruition. In the private sector, decisions to continue or cease development efforts are disciplined by the realities of the market, which provides a measure of outcome to which all members of the firm must adhere. In general, the structure of a business firm also makes it clear who will be responsible for various levels of decision. If a member of the firm does not agree with the decision that is made, he has little recourse except to leave the firm.

In the bureaucracy of the public sector, the incentives are different. Frequently, the bureaucracy will possess multiple goals. In energy, for example, program goals encompass both the development of a technological base and the commercialization of new technologies. More importantly, decisons concerning projects to be initiated or continued are subject to considerable public scrutiny. Public officials do not have the luxury of simply making a decision because they have the responsibility and authority to make that decision; they also must justify those decisions before a considerable number of outsiders, many of whom have quite different views concerning the prospects for a technology, the goals of a program, or the appropriate policy tools to be used. Employees of the agency or their friends outside the agency can frequently appeal the decisions to higher agency officials or to Congress itself. The

debate over the demonstration of the Clinch River breeder reactor shows that even a Cabinet Secretary and the President are unable to make decisions that cannot be overturned.

The incentives of the Government program manager may also be somewhat different from those of his counterpart in the private sector. The latter program manager will frequently report to higher level corporate officers who have had considerable experience with the development of new products and processes. This program manager can easily be rewarded for knowing when to cut off a development as well as for promoting promising ventures because the firm's management appreciates the risks associated with new product development. In contrast, the public official may frequently have to face the scrutiny of an array of elected officials and citizens who do not share his views of the uncertainty and who take the cessation of a project as an indication of failure on the part of the program manager. As a consequence, he may push for a demonstration project despite its low probability of success in promoting the use of an innovation.

These qualities of a Government agency seem likely to inhibit its effective participation in making sound decisions concerning the commercialization of products and processes developed. It will take such bureaucracies a long period of time to make decisions because so many points of view must be considered. Similarly, it will take time to implement decisions when they are controversial because of the several levels at which the decisions can be overturned. It may well be that the necessary absence of profit-oriented goals within public bureaucracies will increase the influence of personal career-oriented incentives of Government officials in the decision process.

Implications for Congress

The narrow scope of usefulness of demonstrations in achieving R&D objectives, the political attractiveness of those demonstrations, the difficulty of achieving the variety of transitions that they seek to make, and the nature of the incentives for Federal R&D agencies suggest four characteristics of programs containing demonstration projects that Congress might encounter.

1. Congress should expect a low rate of success with demonstrations as a means of promoting the use of a technology.

The transition of an innovation from development to use is difficult under any circumstances. It is likely that Federal officials promote technologies having objectives that are not fully shared by either the private sector or by State and local authorities. Demonstrations may frequently not be the policy instrument of first choice but rather the only politically feasible instrument available. Each of these circumstances makes success difficult.

2. Congress should expect that the information it receives concerning the potential of a proposed demonstration will probably be biased and imperfect.

Again, the goals of transition mean that there are few, if any, experts that have appropriate experience or are in institutional settings that do not bias their judgments. Moreover, the fact that demonstrations are frequently the product of a political decision process means that the parties to that process will have different goals for the activity and hence different assessments of likely success.

3. Congress should expect that there will be frequent confusion over the goals of a demonstration project.

The inherent semantic confusion over the term "demonstration" constitutes the first problem. Demonstrations can be used to prove as well as to display a concept. In addition, the perspectives of the actors involved in the demonstration process may be quite different. Some may be certain that the innovation has been proved and seek only to promote its use; some may be dubious and seek to discover its worth; still others may see the demonstration as an easy way to dispose of a political problem and thus will be primarily concerned with satisfying important constituencies.

4. Congress should expect that the evaluation of the success or failure of a demonstration will be difficult and judgmental.

As policies are formulated, a demonstration can provide important but rarely decisive infor-

mation. Moreover, the distribution of policy-making through time and among different institutions and levels of Government makes tracing the value of the outcome of demonstrations nearly impossible.

While at first glance, evaluation of policy-implementing demonstrations appears to be simple, our analysis suggests that it is not. The possibility of goal conflict between Federal and non-Federal sectors, the strength of a technology, or the quality of an institutional environment all affect the outcome. A particular demonstration project may not have spawned a large group of replications but may have illuminated the institutional problems so that future efforts to promote the use of new technologies will be improved. The project may have brought a policy problem to the attention of local government and resulted in continued attempts at that level to deal with the problem. It may have sustained an R&D capability in one or more private-sector firms that will lead to successful new innovations. It may have forced the resoution of uncertainties over environmental or other regulations that will make subsequent investment planning easier.

In light of these expectations, Congress should consider whether other types of policy or program actions will better serve their ends or will complement and enhance the possibilities of successful demonstration projects.

Alternative Strategies to Promote the Use of R&D

Five suggested strategies for improving the chances of successful demonstration projects are:

- Conduct engineering tests.
- Change market incentives.
- Modify the institutional environment.
- Subsidize local development.
- Utilize existing projects.

The Congress, and the Federal Government in general, can benefit by considering these strategies as either alternatives or complements to demonstration projects.

Conduct Engineering Tests

The evidence suggests that if there is a high degree of uncertainty associated with technology, a policy-implementing demonstration will have a high probability of failing to achieve its objectives. If this is thought to be the case, a large-scale prototype test or test-bed experiment may be needed. It may be less expensive, quicker, and more decisive than a demonstration project that has to deal with the problems of a real-world setting. If a major barrier to commercial use of a new technology is technological uncertainty, the resolution of that uncertainty may be a sufficient means of promoting the use of the technology.

In the development of large-scale technology there frequently is pressure both to advance technology and to demonstrate its usefulness in a single project; this appproach can have unfortunate outcomes. Experience with the development of major weapons systems is instructive, although the problems arising in those systems are not fully analogous to the policy problem discussed here. The military has often attempted to compress development times of weapons systems by initially purchasing a sufficient number of completed weapons systems permitting realistic operational testing. In many cases, the production of these test systems has begun before all the technological uncertainties have been resolved. The result has been increased costs, lengthened time schedules, and eroded levels of performance.

Despite this experience, pressures for early test and demonstration continue. Enthusiastic supporters of a weapons system do not want it to be discarded and thus seek the maximum commitment to the system. The industrial producers want to minimize the risk of cancellation. Most importantly, developers and sponsors of new technologies perpetually seem to underestimate the amount of uncertainty that exists with a new technology. Thus,

- ***The* Congress *should seek to ensure that it does not add to the incentives for premature demonstration of an undeveloped technology by pressing to turn engineering tests into full-scale demonstrations.***

IR. L. Perry, Reforms in System Acquisition, The RAND Corporation, P-5482, July 1975.

Change Market Incentives

Barriers to increased market penetration of an innovation frequently have little to do with technological, market, and environmental uncertainties. For example, consider the case of synthetic fuel plants. While there are some technical uncertainties and important issues concerning water rights and environmental damage, the major constraints on commercialization are economic. The price of alternative sources of fuels are simply too low and are expected to remain low enough to prevent the private sector from investing in large synthetic fuel plants.[2] In part, the low price reflects a decision to maintain these fuel prices below the long-term replacement costs through regulation in the interests of other policy objectives. Moreover, the market does not take account ef the value of the increment of "national security" associated with substituting domestically produced synthetic fuel for foreign oil. Perhaps, too, the market does not adequately reflect the interests of future generations who will suffer the consequences of depleted natural fuels.

If the Government determines that it is in the national interest to promote the design and construction of synthetic fuel plants, it could change (or eliminate) the regulations on petroleum prices or it could subsidize the output of synthetic fuel plants. Both actions would allow potential producers of synthetic fuels to respond to market-like forces in ways that seem profitable to them. If such changes are made and alternative sources of fuels are still not developed, either the technology is so uneconomical or the environmental and social impacts so unacceptable that the private sector cannot be expected to develop such plants. If it is politically infeasible to change the regulation of prices or to provide a continued subsidy to new sources of fuel, partial sharing of the cost of an initial "demonstration" plant may be deemed an appropriate form of subsidy. In a sense, the use of a demonstration is a "second-best" solution to commercialization. One should note, however, that in this instance it is unlikely that the demonstration will lead to diffusion of the technology. The fundamental reason for the lack of commercialization has little to do with the absence of the type of knowledge produced by the demonstration. Moreover, if the subsidy were high, that is, if the Government paid a substantial and possibly open-ended share of the cost, many of the valuable indicators of economic viability would be lost. In sum,

- ***When a demonstration is proposed to overcome Government-created market imperfections, serious consideration should be given to altering those imperfections as an alternative to large-scale involvement in demonstration projects.***

Modify the Institutional Environment

The analysis in chapter IV suggested that demonstration programs were not likely to be successful in promoting the diffusion of technologies when the institutional environment is poorly developed. As either an alternative or complement to demonstration projects, the Government may wish to alter the institutional environment.

Earlier we noted that the Department of Agriculture has sought to develop a strong institutional environment as a means of improving the productivity of agriculture through R&D. It was able to do this in part because of the overwhelming importance of agricultural production in the last century. The resulting system has been the product of more than a century of development, has many critics as well as admirers, but has provided a framework within which strong technologies could develop and diffuse.

It is difficult to imagine that the Nation would want to create for other sectors a system as elaborate as that serving agriculture. Less extensive changes can be made, however. For example, the current efforts to promote nationwide performance standards for construction can be seen as a means of simplifying and strengthening the institutional environment. Funding for improved planning, analysis, and research capabilities in local governmental units may be an effective means of improving their capabilities to assess and utilize new technology. Standards developed by the National Bureau of Standards may help the market perform more satisfactorily. Assistance to new industries, either through tax incentives or through specialized technical assistance, may strengthen the institutional environment. On occasion, the Federal Government can promote

[2] Edward W. Merrow, Constraints on the Commercialization OJ Oil Shale, The RAND Corporation, forthcoming.

improvements by bringing elements of State governments together to seek common perceptions of social problems and solutions. Federal authorities can also foster the development of new curriculum and support the training of personnel in the skills necessary to improve the innovative capabilities of the State and local government.

As with any policy, such attempts to improve the institutional environment should be preceded by efforts to determine the real nature of the problem. For example, it has been argued that local schools lack the capacity for useful problem solving. Consequently, proposals have been made for educational extension agents, teacher centers, technical assistance agencies, and other forms of assistance. It is quite possible, however, that the real reasons for the lack of desired improvements stem from the incentive structures that face teachers and administrators at the local level, from the type of training that is provided in teacher's colleges, or from the pressures that changing societal norms are imposing upon the schools. Developing better problem-solving skills may accomplish little. In the absence of good problem diagnosis, attempts to improve the institutional environment may simply lead to additional expensive complexity in the environment. To paraphrase,

- ***Congress should regard policies that seek to develop institutional environments as complements to R&D policies.***

Subsidize Local Development

When a technology of low reproducibility or a poorly developed institutional environment is coupled with a demonstration, Congress may want to subsidize local development efforts to focus attention on a problem of national concern. Such subsidies permit local units of government to implement the forms of new technologies that they want and to modify them in ways that seem appropriate to their particular situations.

There is a growing literature on these types of programs. [1] In general, it has been found that a disappointingly small number of programs survive the withdrawal of the Federal subsidy. Par-t of this low-survival rate reflects the opportunistic behavior that characterizes some local government and educational institutions. Also, the bureaucratic needs of local governments may not be served by many of the developments that are attempted. Innovation is never easy, There is a wide range of plausible explanations for the low rate of incorporation of results, and it would be premature to suggest that the observed rate of incorporation is the best that can be obtained. Thus,

- **The *Congress* should seek the *type of experimentation and evaluation that will cast light on the best means to provide subsidies for local development and to incorporate the findings in new or revised legislation.***

Utilize Existing Projects

For some social policies, existing projects or programs may provide information that can only be marginally improved by introducing a new policy-formulating demonstration. In the congressionally mandated program examining means to provide incentives for efficient delivery of health care, such an approach was taken. Health care reimbursement systems already under development or in use by several States were evaluated to provide information about the potential effects of several different approaches to the problem.

There are many advantages to using existing projects. Since they already exist, information can be more quickly obtained than would be the case with a new project. Many of the costs of starting a project will already have been incurred. It is possible that the information on implementation problems will be more reliable than would be the case with a federally funded demonstration. On the other hand, the existing project may inadequately reflect important policy options; the project managers may resist being evaluated by Federal agencies; or the project may be structured in ways that make determination of outcomes difficult or impossible. The last case would occur if several policies had been simultaneously implemented in a way that prevented the separation of outcomes attributable to each policy. To summarize,

[1] See, for example, Robert K. Yin, Karen A. Heald and Mary E. Vogel, Tinkering with *the System,* Lexington Books, Lexington, Mass., Chapter 5, 1977; and Paul Berman and Milbrey Wallin McLaughlin, Federal *Programs Supporting Education Change,* Vols. I-IV, The RAND Corporation, R-1589 1-4-HEW, April 1975.

- ***In contemplating possible policy-formulating* demonstrations, *the executive branch and Congress should first consider existing sources of insight concerning the policy.***

Suggested Questions To Be Examined in Congressional Review of Demonstration Projects

In cases where these suggested strategies are either undesirable or infeasible or where demonstration projects seem to be the most attractive means for achieving a policy goal, the analysis presented in this report indicates a number of questions that Congress should bear in mind as it performs its legislative functions:

- Are the goals for a demonstration project clearly articulated and agreed upon?
- Given the purposes of a demonstration project, have the information needs of the demonstration's audience been adequately considered?
- If the demonstration is intended to promote the diffusion of an innovation, have the relevant parts of the institutional environment been involved?
- Is the technology underlying the innovation adequately developed?
- Is there sufficient evidence of commitment to the demonstration by the performer?
- Does the design of the demonstration project reflect the experiences of past demonstrations?

Each of these questions is discussed in the following pages.

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

In some instances, demonstration projects fail simply because of conflicting goals among funders, performers, and potential audiences. As noted, divergence in opinions concerning goals for demonstrations are inevitable given the project's policy role. Inadvertent lack of clarity in goals should be avoided, however. When authorizing demonstration projects or programs, Congress should clearly state its intent. When overseeing the conduct of programs under these authorizations, Congress should seek to ensure that program managers and the performers of demonstrations share an understanding of the purposes of demonstrations.

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

Demonstrations, whether conducted to inform Federal policy or to promote the use of an innovation, should be focused on the information needs of its particular audience. A careful analysis of their needs should precede the initiation of a demonstration. It is important to decide what information a demonstration must provide and how it will be conveyed. It is equally important to decide what information a demonstration cannot generate and make that clear to the intended audience. The Congress should seek to ensure that this has been done.

• If the demonstration is intended to promote the diffusion of an innovation, have the relevant parts of the institutional environment been involved?

Evidence and common sense suggest that the institutions important to the success of the demonstration should be involved in its planning and conduct. This includes, for example, those who must change the existing regulations to permit the use of an innovation, the industrial firms that will supply the innovation, and the professional groups that will sanction its use.

Involvement does not necessarily mean participation. It is clear it would be difficult and time-consuming to arrange the participation of all relevant elements of an institutional environment in decisions concerning the design of a demonstration project. Involvement may include, for example, consultation, specialized dissemination of results, participation in evaluating projects, as well as participation in the demonstration project itself. Congress should ascertain that adequate attention has been given to this involvement.

• Is the technology underlying the innovation adequately developed?

Evidence in the literature suggests that when substantial technological uncertainty surrounds a

proposed innovation, the purposes of the demonstration can be compromised. Costs will escalate. Potential users of the innovation may perceive it as unreliable. Compromises in the conduct of the demonstration will then have to be made to accommodate resolution of the technical problems. Congress should seek to ensure that the technology associated with the demonstration is sufficiently well in hand to preclude technological problems from dominating the outcome of the demonstrations.

- Is there sufficient evidence of commitment to the demonstration by the performer?

The difficulties and the complex array of incentives associated with any demonstration project make commitment on the part of the participants an important factor in its success. In the private sector, the best indicator of such commitment is the willingness to assume a substantial share of the costs of the demonstration. Experience also suggests that projects that are conceived by the private or State and local sectors themselves are more likely to have this commitment than projects developed in response to detailed solicitation by Federal agencies.

In a few cases, this type of indicator maybe inappropriate. A willingness to invest funds implies a belief that the conduct of the demonstration is clearly consistent with the goals of a firm or organization. For some innovations, however, there will be Federal interest in promoting goals that are not currently consistent with those of private firms or public agencies. For example, the use of cable television to deliver social services to the aged and the poor may require changes in the behaviors of social service agencies and costs to cable television franchises that are unlikely to be recovered through fees. It may be impossible to implement an innovation like this in the absence of almost total support from the Federal Government. Demonstrations of programs dealing with a new and difficult clientele face similar problems. Much of the Federal involvement in elementary and secondary education was brought about by the failure of the Nation's school systems to deal adequately with the needs of disadvantaged students. Given that these schools did not consider this problem to be important, it is unlikely that they would have been willing to make a substantial financial commitment to demonstration projects dealing with the problems of the disadvantaged.

In general, however, Congress should abandon cost sharing as a measure of commitment only if the goals of the demonstration are of significant national importance, and if the potential gains from the demonstration outweigh the higher probability of its failure when the performers are unwilling to make financial commitments.

- Does the design of the demonstration project reflect the experiences of past demonstrations?

The failure of a demonstration project to contribute to formulating a policy or promoting the use of an innovation is not necessarily an indication of wasted public funds. As we have repeatedly noted, the task that a demonstration project seeks to perform is difficult. Apparent project failures may well reflect problems with the institutional environment, conflicting goals at differing levels of government, or other factors discussed in this report rather than poor management or inadequate funding.

These failures are likely to contain important lessons and may point the way to better future policy and program design. For example, while the ambitious demonstration of educational television has left comparatively little in the way of significantly changed patterns of instruction, it has heightened our knowledge concerning the process for changing these instructional patterns. Cable television demonstrations and experiments have clarified the conflict between the incentives driving the expansion of commercial markets for cable systems and the desire to use such systems to enhance the access to services by disadvantaged groups in society. Demonstrations of solar heating and cooling have served to highlight aspects of the institutional environment to be developed.

The lessons learned from these demonstrations can lead to policies to encourage the development of the institutional environment. They can provide guidance for future technological developments. Congress should promote efforts to learn these lessons, and, where appropriate, encourage new demonstrations that reflect them.

The Future Use of Demonstration Projects

Demonstrations constitute fascinating policy tools. They provide opportunities to try innovations; they can be used to promote important causes; they are exciting experiences, for both sponsors and performers. But demonstrations are also easily misused. They can lead to waste, frustration, and discouragement. We hope that the concepts and guidelines developed in this report will help Congress and others to improve the use of demonstrations in pursuing national goals.