



COMMENTARY RESULTING FROM A WORKSHOP ON THE DIFFUSION AND ADOPTION OF INNOVATIONS IN ENVIRONMENTAL PROTECTION

**A COMMENTARY BY THE EPA
SCIENCE ADVISORY BOARD**

November 22, 2000

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Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: Science Advisory Board (SAB) Commentary Resulting from a Workshop on
the Diffusion and Adoption of Innovations in Environmental Protection

Dear Ms Browner:

On June 28, 2000, a new subcommittee of the EPA Science Advisory Board's Environmental Engineering Committee held a workshop on the "Diffusion and Adoption of Innovations in Environmental Protection" to provide a consultation on three Agency program areas at the request of the Program Offices. At the workshop, the Subcommittee concluded that the Agency as a whole might benefit from general advice that would improve the Agency's efforts to diffuse environmental innovations of potential significant value to adopters. The purpose of this Commentary is to provide this broader advice.

At the workshop, the Subcommittee on the Diffusion and Adoption of Innovations in Environmental Protection heard briefings from representatives of the Office of Water on issues associated with the diffusion and adoption of the Watershed Approach and the use of social science tools, including community cultural assessment. The Subcommittee also received a briefing from a representative of the Office of Pollution Prevention and Toxics, who spoke about issues associated with the diffusion of new approaches to Multi-Media Persistent Bioaccumulative Toxins (PBT) and pollution prevention generally. As part of the consultation that occurred at the workshop, individual members of the Subcommittee provided specific advice to these program representatives. Their goal was to show how data, theories, and research methods derived from the study of the social process of diffusion and adoption of innovations could have practical applications to these specific EPA efforts.

After the workshop discussions with program staff, and after hearing two general presentations by senior managers in the Office of Policy, Economics, and Innovations on the past decade of innovations in environmental protection, the Subcommittee came to a conclusion it believes is important to the Agency overall in its efforts to diffuse innovations in environmental protection.

The Subcommittee recognizes, from the presentations received and the documentation provided, including *Innovation at the Environmental Protection Agency; A Decade of Progress*, that the Agency is devoting serious attention to innovation in environmental protection. The

Subcommittee believes that the Agency's commitment to innovation needs to be balanced by an increased commitment to diffusion of innovations of potential significant value to adopters. From the information presented before and during the workshop, the Subcommittee concluded that the Agency is not taking a strategic approach that makes the best use of available information about the diffusion and adoption of innovations. The Subcommittee believes that the social process of diffusing important new ideas and approaches is less well understood at EPA than the process for generating new ideas and approaches. The Agency could benefit from consulting the wide variety of social science literature related to the effective diffusion and adoption of innovations. EPA could use insights from this body of research to design well-considered diffusion plans that would guide and facilitate the adoption of innovations in environmental protection and help to evaluate rigorously their success.

The attached brief commentary sketches the major insights reached by our Subcommittee members during our short one-day meeting as they apply to: (1) the different frameworks and approaches available for understanding the diffusion process at EPA; (2) the principal barriers to diffusion and adoption of innovations; and (3) how EPA can effectively measure the success of its diffusion and dissemination efforts. The Subcommittee concludes that the Agency would benefit substantially from a modest research and demonstration effort aimed at utilizing current knowledge in the social sciences concerning strategies and techniques of diffusing innovations. Future consultations with the SAB could help the Agency determine the scope and specific directions of that potential research.

We look forward to responses to this Commentary from the Associate Administrator for the Office of Policy, Economics and Innovation, the Assistant Administrator for the Office of Water, and the Assistant Administrator for the Office of Pollution Prevention and Toxics. In particular, we would like to know how useful this workshop was to them, and how useful they expect the information contained in this commentary to be for their programs.

Sincerely,

/s/

Dr. Morton Lippmann, Interim Chair
Science Advisory Board

/s/

Dr. Hilary Inyang, Chair
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/s/

Dr. Roger Kasperson, Chair
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ABSTRACT

This Commentary reflects advice developed at an SAB Consultative Workshop held on June 28, 2000, by the Environmental Engineering Committee's Subcommittee on the Diffusion and Adoption of Innovations in Environmental Protection. The purpose of the workshop was to provide specific advice to the Office of Water and Office of Pollution Prevention and Toxics to identify how the use of data, theories, and research methods derived from the study of the social process of diffusion and adoption of innovations may improve the adoption of innovative approaches to environmental protection: a) within EPA; b) by state, tribal, and local government partners; and c) by corporate and non-governmental organization partners in environmental protection.

The Commentary goes beyond the specific advice provided to those program areas to address more generally: a) the different frameworks and approaches available for understanding the diffusion process at EPA; b) the principal barriers to diffusion and adoption of innovations; and c) how EPA can effectively measure the success of its diffusion and dissemination efforts.

The Commentary states that the Agency would benefit substantially from a modest research and demonstration effort aimed at utilizing current knowledge in the social sciences concerning strategies and techniques of diffusing innovations.

Key Words: Innovations, Diffusion and Adoption, Environmental Technologies

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1. INTRODUCTION

On June 28, 2000, the Science Advisory Board's Subcommittee on Diffusion and Adoption of Innovations in Environmental Protection met to provide advice requested by three Agency programs. The purpose was to provide practical advice from individual Subcommittee members to staff in EPA's Office of Water and Office of Pollution Prevention and Toxics. This advice concerned how they might improve the diffusion of new approaches to environmental protection through use of insights researchers have gained from the study of the social process of diffusion and adoption of innovations. A record of the advice provided may be found in the minutes of the meeting, attached to this Commentary in Appendix A. These minutes have been accepted by the Chair and the members of the Subcommittee.

The purpose of this document is to convey a broader message to the Agency based on the conversations that occurred during the one-day workshop, including conversations with managers from the Office of Policy, Economics and Innovations and review of materials received in advance of the Workshop. The Subcommittee believes that if the Agency desires to diffuse new approaches to environmental protection more broadly, both within and outside the Agency, EPA's commitment to innovation needs to be better balanced by an increased commitment to diffuse innovations. The Subcommittee believes that the Agency could benefit from a better understanding of the social processes of diffusion of innovations and from the use of data, theories, and research methods derived through the study of those processes by social scientists.

This Commentary will sketch some of the Subcommittee's general advice to the Agency on how it might explore and apply insights from a variety of research to the general problem of diffusion of innovations. The Commentary is organized to address three general questions that relate to all the program areas discussed during the Consultative Workshop held on June 28, 2000 and to the broader issue of diffusion of innovations for EPA:

- a) What are the principal models available for understanding the diffusion process?
 - 1) What is the role of information and information flow in diffusion and adoption of innovations? How can EPA become more effective in disseminating information?
 - 2) What have we learned about designing appropriate incentives for facilitating the adoption process?
 - 3) How important are social networks to the process of diffusion and adoption of innovation? How can EPA better recognize and use such networks?

- 4) What can EPA learn from diffusion efforts undertaken by other partners in environmental protection (state and local agencies, tribes, non-governmental organizations, and corporations)
- b) What are the principal barriers to diffusion and adoption of innovations in selected EPA program areas?
- c) How can EPA effectively measure the success of its efforts to encourage diffusion and adoption of innovations?

This Commentary will sketch the Subcommittee's response to these questions, based on discussions at the Consultative Workshop and materials received beforehand. It will also offer some specific recommendations indicating how the Agency might develop plans designed specifically to increase the success of diffusion of new ideas and approaches.

2. PROCESS MODELS

The Subcommittee believes that EPA would benefit from developing strategic plans focused on the diffusion of innovations and from understanding that such plans are different from plans used for communicating or marketing new ideas to individual people. The latter focus on individual persons or even groups acting independently from one another, while diffusion-based strategies assume a social relationship among potential adopters of an innovation and seek to make use of existing relationships and the influence among the people who are party to those relationships to encourage adoption of the innovation.

One well-established framework for understanding the process of diffusion is found in the “Diffusion of Innovations” (Rogers 1995). That book, which is a primary source for understanding diffusion, defines *diffusion* as *a process by which an innovation is communicated through certain channels over time among members of a social system*.¹ It presents a framework with four main elements: a) characteristics of the innovation; b) communication channels; c) time; and d) the concept of critical mass.

The framework suggests that certain innovations will be adopted more rapidly than others if they have five characteristics. Innovations are diffused more readily if they are perceived by individuals as having greater relative advantage. They also need to be compatible with existing values, past experiences, and needs of potential adopters. Widely diffused innovations are marked by of “trialability;” i.e., they may be experimented with on a limited basis. The results of the innovation need to be visible to others. Finally, such innovations are marked by a relative lack of complexity and are perceived as easy to understand and use.

The framework also suggests that choice of channels for communicating an innovation is a key to its successful diffusion. Most individuals evaluate an innovation on the basis of the experience of peers who have adopted it and not on the basis of scientific research by experts.

The dimension of time is also key to the framework. The framework describes the process of an individual’s decision making regarding an innovation and the phases involved. There are five categories among members of a social system, who generally adopt innovations in sequential stages and at a fairly predictable rate: a) innovators; b) early adopters; c) early majority; d) late majority; and e) laggards.

The final part of the diffusion framework is the concept of critical mass, which occurs at the point at which enough individuals have adopted an innovation so that the innovation's further rate of

¹ *Social system* is a term used in a variety of ways in the social sciences. As used in this report, a social system is a set of members or components (people, institutions, communities) with rules and relationships by which they interact, and ongoing communications among them.

adoption becomes self-sustaining. The framework stresses that early adopters are instrumental in moving an innovation to the point of critical mass, and hence, in the successful diffusion of an innovation.

Knowledge, ideas, norms, beliefs, services, and products have all been considered innovations in diffusion studies. The framework for diffusion research developed from the successful diffusion of hybrid seed corn among Iowa farmers in the 1940s. Recent studies have traced the diffusion of the innovation of kindergarten across cultures throughout the world (Wollons, 2000); the spread of policies favoring school choice among the 50 states (Mintrom, 2000); and the diffusion of tobacco control throughout North America (Studlar, 1999). The U.S. EPA has sponsored diffusion research about perceptions of EPA-funded hazardous waste clean-up technologies by industrial scientists, state environmental regulators, and consulting engineers (Dearing, Meyer, and Kamierczak, 1994). Members of the Subcommittee provided the Office of Water and Office of Pollution Prevention and Toxics with suggestions about application of the framework and the potential use of other results from diffusion research to their work at the Workshop on June 28, 2000 (see Appendix A for the specifics of those conversations).

The framework for diffusion has a number of distinctive features. It defines diffusion as a social process and suggests that the extent of the flow of information through social channels can be more important than the actual content of the information in the communication. It distinguishes the process of diffusion from the original innovation and stresses the importance of identifying individuals within a social system who are perceived as influential by the target individuals. Based on this framework, the central tasks for EPA are: a) to understand networks in the organizations and social systems that facilitate the flow of information to key individuals who can influence others – and to understand that those key individuals may not just be those who have formal power or authority; and b) to identify and assess barriers that can impede this information flow or the adoption of the innovation.

These tasks suggest that the Agency needs to identify clearly the targets of the diffusion effort and also understand their behavior and social systems. The Agency might conduct in-depth social network analysis, employing a tool like the draft community cultural assessment guide, developed by the Office of Water and discussed at the Workshop, to understand the perceptions of influential individuals or groups in a social system, or work with organizations such as business associations or communities to understand how they might encourage adoption of new approaches (see Clarke, 1998, for examples of social networks in business and how they were used for cleaner technology diffusion).

The identification of influential people in diffusion processes can be accomplished in at least four ways: through the conduct of a quantitative social network analysis, or, when such detail isn't feasible or desirable, through informant ratings of others, self-ratings of social influence, or personal observation of social behavior (Weimann, 1994). EPA would then tailor a diffusion plan to particular influential groups or persons.

State pollution prevention programs have developed various techniques for promoting the diffusion of cleaner technologies. For instance, the Massachusetts Toxics Use Reduction Program has used sector-specific focus groups, state-trained and certified "toxics use reduction planners," grants to community organizations, and publically accessible technology demonstrations at industrial facilities to promote awareness of new technologies and to stimulate dialogue among influential individuals.

The study of social networks² may be used to supplement the framework described above. Research on such networks suggests that individuals or groups located in two or more networks that are not normally in contact with each other can be especially influential in transferring ideas and becoming opinion leaders (Burt, 1990; 1995). The Subcommittee believes, for example, that groups like Publicly Owned Treatment Works (POTW), which function as both regulators and regulatees and which share networks with many other organizations, present strategic targets for EPA because of their influence over a wide variety of other entities.

For EPA, it may also be possible to motivate individuals and organizations to adopt innovations by highlighting the risks of maintaining the status-quo. Research indicates that firms in the Great Lakes first undertook pollution prevention efforts due to regulatory pressures (Durfee, 1999). Some of these firms now engage in continuous change because they see it as conferring competitive advantage. As multiple firms view innovation as conferring a competitive edge, diffusion may take hold. Competition among socially equivalent individuals or firms can make sticking with old ideas and technology look less attractive. The more that firms see a competitive advantage to an innovation, the more risky the policy of no change becomes. EPA may thus consider using regulations or information-based programs like the Toxic Release Inventory as tools to advance innovations in environmental protection. Preliminary analysis of industrial print coverage of pollution prevention, for example, indicates that the main driver for the adoption of pollution prevention is cost savings, with environmental and safety benefits as secondary goals (Fan and Durfee, 1998).

General conceptual models exist for analyzing the diffusion of innovations. Developed to understand state policy innovations, they can be applied to the diffusion process generally. They fall into four different types: a) the national interaction model; b) the regional diffusion model; c) the leader-laggard model; and d) the vertical influence models (Berry and Berry, 1999).

- a) The national interaction model (Gray, 1973) assumes a national communication network among state or local officials in which officials learn about programs in other states. This learning model was developed by communication theorists to analyze the diffusion of an innovation through a social system of individuals. When the cumulative proportion of adopters is graphed against time, the familiar S-shaped curve described in the *Diffusion of Innovations* appears.

² *Social networks*, as used in this report, refers to a complex of interacting social units that are tied together by communication linkages.

- b) The regional diffusion model assumes that entities are influenced primarily by other entities that are geographically close to them, or in the same region. Neighbor models assume that states are influenced primarily by those states with which they share a border (see, for example, Berry and Berry, 1990), while fixed region models assume that the nation is divided into multiple regions and that states tend to emulate the policies of other states within the same region (Mooney and Lee, 1995 and Mooney and Lee, 1999). Reasons for emulating each other include learning, shared cultures, competition and public pressure. While regional identity is probably not as strong as it was 60 years ago, there is still considerable evidence that regional influence affects policy diffusion.
- c) The leader-laggard model assumes that certain entities are pioneers in the adoption of a policy, or a type of policy, policies, and that other entities emulate these leaders in a learning process. This model can incorporate either regional or national leaders. In environmental policy, one assessment of the top innovative states has named: Maine, Oregon, Connecticut, New York, Minnesota, New Jersey, Rhode Island and Wisconsin as the top ranking states (Hall and Ken, 1991). EPA might consider targeting these states or other states recognized as regional or national leaders to spearhead the diffusion process.
- d) In the vertical influence model, states and other organizations emulate the national government both through policy learning, and because of incentives that the federal government provides. Typically these are financial incentives from a grant-in-aid program. Welch and Thompson in a 1980 study found that policies for which the federal government offers financial incentives diffuse faster than policies lacking such incentives (Welch and Thompson, 1980).

Process models also suggest the importance of “policy entrepreneurs,” the people who develop ideas and, more importantly, the people who promote ideas in the policy arena or in an Agency. The work of political scientists on policy entrepreneurs has shown how they bring their personal credibility, their effective communication and problem-solving skills, their networks of friendships and power, their ability to redefine innovations to the specific setting, and their cheerleading when things bog down (see Berry and Flowers, 1999; Roberts and King, 1996; Howell and Higgins, 1990; and Doig and Hargrove, 1987). This research likens the policy entrepreneur to the pilot who navigates the treacherous terrain that ideas and innovations face to bring them safely into port. Thus policy entrepreneurs are necessary, if not sufficient, for policy adoption and implementation to occur, and cultivating them may have special importance for EPA.

Finally, the Subcommittee suggests that EPA, when attempting to diffuse innovations, give attention to the characteristics of the organizations it is trying to affect and ask "how fertile is the ground for the innovation?" It is essential for the Agency to identify the attributes of organizations that quickly recognize an innovation when it becomes available and act on this recognition. In efforts to diffuse

innovations to states, businesses, and community organizations, it would be helpful to pick on an "appropriate intermediate target" that can recognize an innovation, act on it, and then influence others.

Research in organizational sciences suggests that some organizations have developed capabilities for innovation that may guide the Agency in choosing organizations likely to be successful targets for diffusion (Abrahamson, 1997; Bantel and Jackson, 1989; Damanpour, 1991; Dewar and Dutton, 1986; Etlie et al., 1984; and Kimberly and Evanisko, 1981). In these organizations, capabilities for innovation apply both to the routine and familiar and to new tasks and problems (Cohen and Levinthal, 1990; Dewar and Dutton, 1989; Duncan, 1976; and Nord and Tucker, 1987). Such organizations have approached these kinds of innovations in a systematic way, through reframing problems, incentives, goal setting, and training (Bartunek, 1988; March, 1991; Sitkin et al., 1992; Sutcliffe et al., 2000; and Wildavsky, 1988). Research suggests that their propensity for innovation and risk is not an inherent trait. Instead, the ability and willingness to take risks are cumulative; they build up over time as organizations develop experience in dealing with risks and innovation (Barney, 1995; Christmann, 2000; Henderson, 1994; Henderson and Cockburn, 1994; Jelinek and Schoonhoven, 1990; March and Shapira, 1987; Sitkin, 1995; Sitkin and Pablo, 1992; and Van de Ven et al., 1989).

Individual perceptions of threats and opportunities are mediated by their cultural and structural context -- and organizations form one of the most significant influences on how potential innovations are viewed and how their anticipated impact will be perceived (Abrahamson, 1997; Dougherty, 1992; Kimberly, 1979; Kimberly and Evanisko, 1981; Lei et al., 1996; and Van de Ven et al., 1989). Some organizations are better absorbers of new approaches and technologies because of their top leadership, their culture, their procedures, or their personnel (Bantel and Jackson, 1989; Barney, 1986; Cohen and Levinthal, 1989; and Cardinal, in press). Yet others are better facilitators of individuals' adoption of innovations due to an ability to reduce barriers to adoption or an ability to increase incentives for adoption (Adler and Borys, 1996; and Sitkin et al., 1994).

Part of the promise of this literature on diffusion for EPA is the user-centered perspective that it can bring to the Agency. This view suggests that, ultimately, the perspectives of innovation developers do not matter much; the perspectives of potential adopters matter a great deal. Research clearly shows the high degree of reinvention of innovations that occurs after users adopt innovations, including those from Federal agencies (Dearing et al., 1998).

3. BARRIERS AND ENABLING FACTORS

The Subcommittee finds that the Agency is aware of many barriers involved in the diffusion of innovations in environmental protection, for example: a) innovations that prevent adverse effects from occurring, like most innovations in environmental protection, tend to have a relatively slow adoption rate; b) innovations in large, complex organizations are more complicated and slower; c) innovations are difficult in organizations where standard operating procedures are deeply ingrained and resistant to change; and d) a tradition of solving environmental problems issue-by-issue and medium-by-medium frustrates new approaches.

There are, however, some barriers to innovation that merit more attention in the Agency. At times, EPA's environmental innovations involve multiple, complex goals or changes. A single innovation can affect targets as diverse as states, watershed groups, other federal agencies, agricultural interests, and EPA itself, as in one diffusion effort discussed at the workshop. The Subcommittee believes that the more clearly the Agency can define and focus its diffusion efforts, the more effective the diffusion efforts will be. Similarly, the more clearly EPA can identify the specific persons, organizations or entities that it seeks to adopt innovations, the better the diffusion strategy will be (Huber and Glick, 1993; Van de Ven et al., 1999).

Another barrier is EPA's past inability to take full advantage of its unique set of relationships with groups interested in and affected by environmental protection programs. Although the Agency is in contact with many networks that are not normally in contact with each other by virtue of its many clients, these relationships are not used fully as important resources for the Agency. Such relationships can be used as resources only when individuals in the Agency can knit their different networks together, both within EPA and with its many partners.

Additional significant barriers to successful diffusion of innovations are the Agency's lack of expertise in the social and organizational sciences and its lack of recognition of the need to study social groups, networks, and agents of change. Policymakers appear to be willing to invest in research on the behavior of brown trout, or a species of chemical, or an environmental technology, but are far less willing to invest in research on the values and behavior of individuals who they hope will adopt change. Yet those individuals are often the sources of environmental stress and the source of solutions to environmental problems. The Subcommittee believes that the EPA needs to understand more fully that successful diffusion programs require a well-conceived strategy for success.

Major factors that enhance the successful diffusion of innovations are discussed above in Section 3 and described in detail in the *Diffusion of Innovations*. Previous diffusion research provides a valuable basis for fine-tuning innovations prior to attempts at diffusion to ensure that potential adopters (such as Agency managers) perceive the innovation positively. For example, the attributes of innovations that mark them as mostly likely to be diffused successfully (see above, Section 2) can be

used to assess perceptions for EPA innovations of all types, from technical to managerial. Innovation attributes can also be used when Agency personnel seek to learn which of a set of similar innovations are most positively perceived by potential adopters (Dearing and Meyer, 1994).

Finally, the Agency might take advantage of the public's good will regarding environmental protection when crises arise, as several other Agencies have done, to increase public awareness of the benefits associated with innovations. EPA might learn from the example of the Centers for Disease Control and Prevention (CDC), which has consciously tried to use knowledge of health crises in a strategic way to advance innovations. As policy analysts (Kingdon, 1995) have argued, "policy windows" exist where the prospects for change are greatly enhanced. When there is advance knowledge of a health crisis, one of the units at CDC designs a strategy before the event to take advantage of that opportunity to promote changes that would have prevented the crisis. The unit also designs a program on the anniversary of the crisis for the same purpose.

4. MEASURING THE SUCCESS OF DIFFUSION EFFORTS

The Workshop indicated that Agency representatives involved in diffusion efforts are often uncertain what success involves and what metrics for success might be. Defining, measuring, and evaluating the success of efforts to diffuse innovations in environmental protection need to be part of the Agency's overall approach to innovation. These elements are necessary for several reasons. They make innovations attractive and operational, since almost every state and local government has adopted performance-based budgeting. Staff in state legislatures, state agencies, and other large organizations are seeking outcome and output models for their programs (Wholey, 1999; Berry, Brower, and Flowers, 2000; and Newcomer, 1997) .

Evaluation is also needed so that the Agency can communicate clearly the nature of specific innovations and their benefits to those EPA hopes will adopt the new ideas, approaches, or technologies. Defining, measuring, and evaluating success in the diffusion of innovations will also help the Agency manage and refine its approach to environmental management. Experience across the federal government, including the U.S. Department of Agriculture and EPA's own Brownfield program, has suggested several models of how the Agency might proceed in developing in evaluating innovations, especially the link between new programs and applied research and policy goals (Marshall and Bennett, 1998).

Well-designed approaches to measurement and evaluation depend on the characteristics of the particular innovation to be diffused, the intended target, the nature of the barriers, and the Agency's goal in diffusing the particular innovation. The Subcommittee suggests that a program to evaluate the success of particular diffusion efforts be designed not only to collect useful information for those efforts but also to provide larger insights and systematic learning on EPA's efforts to diffuse innovations generally. Such a program might address the following elements: a) was the innovation adequately communicated?; b) did EPA understand the social networks among the target entities?; c) were data captured on the numbers/proportion of entities potentially able to adopt it that actually did?; d) were implementation and use of the innovation measured, and not just the adoption of a policy?; e) were measures of expected behavioral or process changes resulting from the innovation tracked and used for evaluation and assessment of success?; f) were models employed examining relationships among activities, environmental outcomes, and indicators/measures?; g) were data assembled on why the innovation was or was not adopted? If models for such measurement and evaluation are not readily available, EPA would benefit from developing some case studies evaluating the diffusion of innovations and providing the results as interim guidance.

It is important that EPA communicate that such case studies and guidance are provisional, so that potential adopters are not deterred by inflexible that would squelch one of the key characteristics of successful innovations--the potential for reinvention. Adaptation and successful response to changing problems are hallmarks of innovative organizations (Sitkin et al., 1994; Sutcliffe et al., 2000; and Van

de Ven et al., 1999). Measurement and evaluation must not erect impediments to adopting and adapting environmental protection innovations EPA wishes to promote (Cardinal, in press; Jelinek and Schoonhoven, 1990; March, Sproull, and Tamuz, 1991; Jaeger and Baliga, 1985; and Tamuz, 1987).

5. DIFFUSION PLANS

EPA experiences in diffusion of innovations at the Workshop revealed that such efforts currently tend to proceed in an *ad hoc* manner, usually based on the particular insights of the personnel charged with the task, with very general and sometimes ambiguous goals and limited resources. It is apparent that significant improvements in current diffusion practice could be achieved through the development of strategic diffusion plans preceding the initiation of any Agency efforts so that specific objectives are stated, analysis of potential obstacles conducted, specification and analysis of target groups undertaken, strategic approaches designed, evaluation strategies identified, and needed resources and implementation time frames estimated. In other words, the Agency should bring to its diffusion of innovation efforts the same kind of rigorous analysis and planning that would be used in establishing a program of scientific research and assessment.

The Subcommittee suggests that the Agency develop a guidance document to assist in the development of these diffusion plans and that this document be regularly updated and improved based on evaluation results. It is beyond the scope of the purposes of this first workshop to specify what the content of these diffusion plans should be and how they may best be designed. A careful retrospective assessment of representative Agency experience to date, combined with the state of knowledge from diffusion research, could provide a sound basis for such a guidance document.

In the Subcommittee's view, the guidance document and these Agency diffusion plans, should address such issues as:

- a) Objectives. The objectives of the diffusion effort should be clearly and specifically set forth. The objectives should be realistic, take account of existing obstacles and Agency resources, and (wherever possible) adopt quantitative targets. These objectives will be essential for defining success and for designing the evaluation program.
- b) Target Groups. Who are the targets of the diffusion effort and what are the characteristics of their organizations and behavior that will bear upon their decision to adopt an innovation? Understanding and mapping the patterns of relationships within and across the organizations that the Agency hopes to influence is an essential element of prospective diffusion success.
- c) Barriers. Prospective anticipated barriers to diffusion should be specified and assessed. One barrier is not knowing who influences whom in a community or organization. Another barrier is not knowing the potential significant value of the innovation to the adopters.

- d) Diffusion Strategy. Based upon the results of the three tasks above, a diffusion strategy should be formulated. Who will be the likely early adopters, who the laggards? In light of the barriers above, what specific techniques and approaches are likely to be most effective?
- e) Resources and Time Frames. A diffusion plan should include an estimate of the resources--financial, personnel, expertise--that will be required for successful implementation. Resource needs in such complicated areas as organizational behavior, community culture, and social network should be anticipated and identified.
- f) Evaluation. An evaluation strategy and procedures should be set forth, including the desirability of beginning the evaluation early so that baselines can be established and adaptations made to the innovation by adopters can be identified and incorporated into the diffusion program as appropriate. These evaluations should be shared broadly within the Agency to build an overall knowledge base.
- g) Peer Review. Like other strategy documents, these diffusion plans should be peer reviewed before action and implementation actually goes forward.

6. REFERENCES

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APPENDIX A: SUMMARY MINUTES OF PUBLIC WORKSHOP, JUNE 28, 2000

U.S. Environmental Protection Agency

Science Advisory Board

**Committee: Environmental Engineering Committee, Subcommittee on the Diffusion
and Adoption of Innovations in Environmental Protection**

Summary Minutes of Public Workshop

Date and Time: June 28, 2000, 9:00 a.m.-5:20 p.m.

Location: Ariel Rios North Building, Room 5530

Purpose: To provide advice on the diffusion and adoption of innovations in three EPA program areas; to answer specific charge questions related to the diffusion and adoptions of innovations in environmental protection.

Attendees: SAB Members and Consultants: Dr. Roger Kasperson (chair), Dr. Frances Berry, Dr. James Dearing, Dr. Mary Durfee, Dr. Kenneth Geiser, Dr. Hilary I. Inyang, Dr. Gordon Kingsley, Dr. Karlene Roberts (by teleconference), Dr. Everett Rogers, Dr. Sim Sitkin, Dr. Laura Steinberg, Dr. Dominico Grasso, Dr. Michael McFarland and Dr. Angela Nugent, Designated Federal Official (DFO, EPA, SAB staff). Other persons attending for the purpose of making presentations: Dr. Jay Benforado (EPA, Office of Policy Economics and Innovation), Dr. Claude Bennett, (USDA), Thomas Murray (EPA, Office of Pollution Prevention and Toxics), Ms. Betsy Smith (EPA, Office of Policy Economics and Innovation), Ms. Theresa Trainor (EPA, Office of Water), and Ms. Louise Wise (EPA, Office of Water).

Meeting Summary

Dr. Roger Kasperson, Chair of the Workshop, opened the session at 9:05 a.m. He welcomed members and consultants, reviewed the agenda, and discussed the charge questions. He called on the Subcommittee members who specialize in the study of diffusion of innovations to provide specific ideas that would be useful to Agency people "in the firing line." He suggested that the Subcommittee had a two-part task: to provide responses to the questions brought by individual EPA program areas and to address the general charge questions regarding the adoption and diffusion of innovation as described in the FEDERAL REGISTER notice.

Dr. Kasperson described some of the background for the Science Advisory Board's (SAB) organizing the workshop. The SAB has an interest in strengthening the EPA's use of the social sciences for environmental protection and has several activities, including a lecture series, underway to advance this goal. He mentioned that a subcommittee member, Dr. Everett Rogers, had presented a lecture in

this series on May 31, 2000. Dr. Kasperson thanked the SAB's Environmental Engineering Committee (EEC) for sponsoring the subcommittee as an activity linked to its interest in the introduction of pollution prevention and other technologies. Dr. Angela Nugent, the DFO, mentioned that the EPA's Reinvention Action Council, a cross-Agency group of high-level managers, currently were examining how the Agency might best diffuse beneficial innovations and that the Agency had recently published a report, "Innovation at the Environmental Protection Agency," which was provided to the Subcommittee.

Dr. Hilary Inyang, Chair of the SAB's Environmental Engineering Committee, added that EPA in recent years has taken steps to address the human factors associated with new technologies. EPA's Office of Research and Development has identified a new mission for its engineering laboratory in Cincinnati and has renamed it the "National Risk Management Research Laboratory." The SAB generally and the EEC in particular have considered several topics in recent years that have addressed social science aspects of new technologies: (1) risk reduction options selection, which addressed non-technological criteria for ranking options; (2) waste reuse strategy; and (3) pollution prevention. He assured Subcommittee members that the EEC will apply their recommendations to the Agency in its upcoming documents.

Members then briefly introduced themselves and described their research; no members identified any activity that would conflict with their providing advice on the topic of the Workshop. The substantive business of the Workshop then commenced, generally following the sequence and timing as outlined in the Agenda.

Introduction to EPA Issues.

1. Watershed Approach. Ms. Louise Wise (EPA, Office of Water), provided an introduction to the Watershed Approach and discussed issues of diffusion and adoption. She defined the Watershed Approach as a continual multi-part process that involves: (1) defining a place bounded by hydrologic drainage features; (2) focusing on the environmental conditions of that place; (3) planning activities to preserve or improve conditions; (4) taking action; and (5) evaluating results. She described the diffusion of the approach as successful overall, yet identified several issues. These issues include: (1) some states apply watershed approach narrowly and focus on only one priority issue, e.g., NPDES permits; (2) federal agencies have had uneven success in different parts of the country in diffusing coordinated delivery of federal services at the watershed level; (3) EPA's own efforts to diffuse the watershed approach consistently have been disrupted by "regulatory tsunamis" [e.g., regulatory efforts to address animal feeding operations, combined sewer overflows] that have not been structured strictly to address watershed-level issues, and have drawn resources and attention from the watershed approach; (4) bureaucratic organizations at the state and federal level are "stovepiped," not integrated to address watershed issues; (5) jurisdictions at the city and county level are not organized along hydrological lines and, as a result, existing jurisdictions make collaboration to address watershed issues difficult; and (6) lack of adequate funding to diffuse the watershed approach.

Ms. Wise described the original strategy for promoting the watershed approach within and outside EPA as a six-prong strategy: (1) try it; (2) advertise it; (3) finance it; (4) develop tools for it; (5) reorient programs to complement it; and (6) measure it (with "it" being the Watershed Approach). Workgroups (called the "Six Pack" were organized to address each prong of the strategy. In determining how to concentrate effort, the Office took a "domino approach" to diffusing the Watershed Approach. The plan was to find multiple ways to influence multiple targets (e.g., states, local governments, watershed groups, other federal agencies, EPA) and to "find where to push to make changes happen." The office began with a focus on states because they implement most of EPA's programs. But as the approach caught on, her office began to target a broader audience. Ultimately, they relied on the internet, brochures, publications, training, technical assistance, and financial incentives to promote the approach. She asked the Subcommittee for advice on how her office's strategies compare to other diffusion models and how EPA can better promote the use of social sciences in watershed approaches at all levels.

2. Multi-Media Persistent Bioaccumulative Toxins (PBT) Initiative/Pollution Prevention. Mr. Thomas Murray (EPA, Office of Pollution Prevention and Toxic check name) provided a briefing that oriented Subcommittee members to the pollution prevention program and the PBT initiative. Mr. Murray prefaced the briefing with an acknowledgment of the factors in Everett Rogers diffusion model that would predict diffusion as difficult for pollution prevention efforts: (1) bureaucratic context; (2) preventive innovations generally identified with slower diffusion rates; (3) diffusion in complex organizations generally slower; and (4) diffusion of innovations frustrated by "stovepiped," rather than integrated organizations.

Mr. Murray described two examples for the Subcommittee to consider. The first involved the diffusion of environmentally preferable cleaners. He described the Executive Order that requires federal agencies to procure environmentally friendly cleaners and EPA's work with the General Services Administration (GSA) to provide information in GSA catalogues about the quality, price, and environmental attributes of cleaners. After several years, EPA is finding that the GSA is not finding environmentally friendly cleaners economical to offer; federal agencies are not purchasing them. In addition, only one municipality, Santa Monica, has successfully adopted use of environmentally friendly cleaners.

The second example illustrated issues concerning the diffusion of pollution prevention efforts within the context of the PBT initiative. Mr. Murray described the Agency's efforts to work with hospitals to encourage the adoption of alternatives to mercury thermometers. Although many hospitals are adopting reliable substitutes, the Agency still encounters resistance from medical doctors who have not been trained in the use of alternate devices, distrust them, and also distrust the risks EPA links to the production, use, and disposal of mercury thermometers.

Mr. Murray concluded by asking the Subcommittee members for advice. He suggested that although pollution prevention was accepted as an EPA "guiding principle," and although people

generally agree on the merits of pollution prevention in the abstract, the Agency generally faces an uphill battle regarding diffusion and adoption of pollution prevention approaches both within EPA and outside. He asked the Subcommittee if the Agency was doing enough to diffuse the approach; whether the stovepiped structure of the Agency was a rate-limiting step; and how to measure the diffusion of the pollution prevention approach.

3. Use of Social Science Tools, Cultural Profiling. Ms. Theresa Trainor (EPA, Office of Water), gave a presentation which asked for advice regarding the plan for diffusing a new social science tool, "Community Cultural Profiling (CCP)." She began her presentation by describing the current state of the social sciences at EPA and the reason for developing the CCP. Ms. Trainor stated that there were 3 significant efforts in the 1990's to identify key social science needs, including a draft Social Science Research Agenda reviewed by the SAB in 1992. She stated that EPA has developed five extramural research programs with some elements of social science, including a grant program on Decision Making and Valuation for Environmental Policies. She commented that non-economic social scientists have found it difficult to get funding within these grants programs. She mentioned that EPA's Office of Research and Development is considering developing a research plan for the non-economic social sciences.

Ms. Trainor identified perceived barriers to the use of non-economic social sciences by the Agency. They include: (1) lack of funding; (2) the perception that social sciences do not have immediate applicable results; (3) lack of incentives for investing in or applying social science; and (4) no mandates calling for social science research or use of the social sciences.

Despite these barriers, in 1995 EPA Regional Staff participated in a survey conducted by EPA's Office of Policy Planning and Evaluation, and identified the need for a tool to help them work with communities. They specified the need for better ways to identify social networks and partnerships, to identify stakeholders, and to aid in the communication of ecological issues. The CCP was designed as a response to this need. The draft CCP is in its final stages of revision. It has been field tested and peer reviewed. The name of the document will likely change to "Community Cultural Assessment Guide."

To date, efforts to diffuse the guide have included pilot testing of the Guide in several locations, training of EPA Staff and Staff of The Nature Conservancy, and an Internet notice of availability of the draft.

Ms. Trainor concluded with her specific questions for the Subcommittee: (1) how best to institutionalize the guide, given perceived barriers described; (2) how to work within EPA's Office of Water to reach diffusion targets; (3) how to work effectively with primary innovators without "burnout"; and (4) how to work effectively to advance use of social sciences within EPA despite multiple reorganizations.

Short overviews of Subcommittee Members' research and how they may relate to EPA Issues.

Dr. Kasperson opened the discussion with several observations about the morning presentations. He noted that the three topics raise similar questions: (1) is there a clear diffusion strategy; (2) are the presenters making correct assumptions about barriers to success; and (3) what are the desired measures of success for each and should those measures be associated with changes in process or outcomes. He noted that all three cases involve a "slow process dealing with hard problems."

Dr. Frances Berry was the first Subcommittee member to discuss how her research interests related to the EPA issues. She drew on her experience with comparing state policy innovations to suggest it might be helpful for EPA, especially with the CCP, to draw a distinction between internal determinants of diffusion and a regional diffusion model. She suggested that social and political factors, as well as the intrinsic characteristics of an innovation, need to be considered. She noted that her research on implementing policy and management reforms suggest five findings: (1) Agency managers need to communicate internally and externally about the innovation and link the reform to the Agency's mission; (2) the best agencies are "ruthless and persistent" about performance management--measures of performance are really important and Agency managers need to develop capacity and processes to allow people to meet those measures; (3) interest groups need to support the mission and the innovation; (4) Agency managers need political capital and good relations with overseers; and (5) EPA needs to eliminate rigid rules and procedures using teams, process improvements and other means to decentralize and be more participatory.

Dr. Mary Durfee next suggested that the research of Ron Burke at the University of Chicago involving network theory might be useful to the Agency. His research looks at social cohesion and contagion of ideas and the diffusion of innovations among social equivalents. The general rule is that the more similar the "ego" and "alter" (i.e., the innovator and the target of innovation) are to each other and to members of their networks, the more likely innovations are to occur. The actual communication efforts involved are less important than the relationships between the innovators and the targets of adoption.

She also suggested that research shows that people or organizations associated with multiple networks [e.g., Publically Owned Treatment Works (POTWs) have networks with other regulated

entities, with other regulators, with engineers, with their clients]⁹ can manipulate those networks for social capital, such as diffusing an innovation - and could be strategic targets for EPA.

Dr. Durfee also suggested that the "stick" as well as the carrot was important to consider in developing a diffusion strategy. She suggested that a person or organization's motivation to avoid unpleasant outcomes can be a powerful incentive to innovate. She suggested that the pollution prevention program capitalize on its targets' desire to avoid regulatory or enforcement actions.

Dr. Karlene Roberts stated that her research focused on risk mitigation in situations where the probability of risks is low and their consequences are high. She is interested in the "culture of confusion" -- factors that prevent dissemination and adoption of new ideas. She also studies how failures in innovation contribute to risk.

Dr. James Dearing commented that his knowledge of diffusion research suggests that there were four mistakes commonly made in trying to disseminate and diffuse a new idea: (1) assuming that involving a minority of people will affect a majority, instead of considering whether the right people are involved at the right time in the diffusion process (case in point: choosing appropriate people to be involved in a pilot so that others are not "put off"); (2) failing to involve people whom others see as influential at a critical, early stage; (3) confusion of mistaken identity - we often confuse people of authority with people of influence; studies of influential people show that they are randomly distributed across different social strata and there is no correlation between influence and power; and (4) failing to note that there are good times and bad times to publicize a demonstration of an innovation; if an innovation is not yet ready to be publicized, people will perceive it as incomplete and too complex, and this perception will lead to negative reactions.

Dr. Kenneth Geiser described his experience in Massachusetts where he runs a program encouraging approximately 500 firms to reduce use of toxic chemicals. Among those firms, he found "lots of innovations" in the introduction of new processes that led to a reduction in toxic materials, but a fairly low rate of diffusion. This low rate of diffusion resulted from: (1) a "lack of observability" because firms could not observe practices in each other workplaces; and (2) firms' reluctance to be seen as early adopters.

⁹ Background note for reader: POTWs are regulated by both federal and state (and sometimes local) wastewater quality discharge limits. Rarely, if ever, can the POTW justify going beyond those limits (which normally translates into higher sewage treatment costs to users - both industrial and residential). However, there are at least two mechanisms that exist within the current regulatory framework by which POTWs can influence the adoption of innovations in pollution prevention. If the POTW is a Type I facility (meaning it is required to have an established industrial pretreatment program), it can promote the use of pollution prevention during its routine inspections of industrial and commercial sewer users. During these inspections, the POTW pretreatment personnel can convey the benefits of pollution prevention to the industrial sewer users including its favorable impact on reducing current and future wastewater discharge fees. Secondly, for those industrial sewer users that have been found to be in violation with their local wastewater discharge permit, the POTW can require the affected facility to adopt pollution prevention measures as part of the enforcement action.

His Institute established a demonstration program to allow firms to try a new technology if they would let others see the innovation in action. The program has funded twenty projects and he concludes that such a mechanism is a powerful vehicle to allow competitors to consider adoption. The experience also showed a wide variation in rates of diffusion. Some sectors showed a lot of interest and innovation; other showed few changes. His conclusion is that certain technologies and situations are ripe for innovation; others are not.

Dr. Everett Rogers suggested that EPA has an advantage in the pool of favorable public good will regarding environmental protection. He proposed that the Agency focus that good will toward advancing innovation when crises arise. He suggested that the Centers for Disease Control has tried to use knowledge of health crises in such a strategic way to advance innovations. One of the units designs a strategy before a crisis happens to take advantage of that opportunity to promote changes that would have prevented the crisis. The unit also capitalizes on the anniversary of the crisis for the same purpose.

Dr. Sim Sitkin described his research as focusing on how organizations can build systematic processes not only for anticipating failures, but also for designing systems so organizations can cope with them and learn from them. His research has distinguished two different types of systems relating to innovations that need to be studied and planned for: (1) Total Quality Management (TQM) systems that apply to the routine and familiar (first order learning), but often are applied to uncertain, nonroutine circumstances where they are inappropriate, and (2) Total Quality Learning, an exploratory or discovery process of second order learning--learning how to do new things--that organizations can systematize (Cohen and Levinthal 1990; Dewar and Dutton 1989; Duncan 1976; Nord and Tucker 1987).

He has studied organizations that seem to be "doing both kinds of innovations well" and that are approaching them in a systematic way (e.g., through incentives, goal setting, training) (March, 1991; Sitkin et al, 1992; Sutcliffe et al, 2000; Wildavksy, 1988). For those organizations, adaptation and updating is the norm, whether the organization is addressing familiar or unfamiliar problems. In each case, individuals in the organization continuously identify problems and the best response.

He suggested that EPA in diffusing innovations give more attention to the characteristics of the organizations it is trying to affect and ask "how fertile is the ground for the innovation?" He suggested identifying the attributes of organizations that can recognize an innovation when presented and then act on them. In working with states and community organizations, it would be helpful to pick on an "appropriate intermediate target" that can recognize an innovation, act on it, and then influence others.

He also suggested that organizational research suggested that propensity for innovation and risk was not an inherent trait. Instead, the propensity for taking risks was cumulative; it builds up over time as organizations develop experience dealing with risks and innovation.

Dr. Laura Steinberg described her research project conducted in collaboration with Dr. Victoria Basolo at the University of New Orleans. It was designed to identify how innovations in

ultra-violet (UV) disinfection of wastewater were diffused and adopted among publicly owned treatment plants (POTWs). She found that adopters focused primarily on current, not future, regulatory considerations, were often not influenced significantly by construction funding incentives, frequently had a champion for UV in the organization, and were attracted by the relative technical advantage of UV over alternative technologies.

The Subcommittee members ended their morning session at 12:00 a.m. and adjourned for lunch and a short introduction to Federal Advisory Committee Act Requirements and to the SAB organization and procedures until 1:00 p.m..

Panel Response to EPA Issues.

1. Watershed Approach. The Chair invited Ms. Louise Wise to begin the session by briefly summarizing her major questions for the committee and providing more information about the Office of Water's "domino approach." Ms. Wise responded that there was general awareness and acceptance of the Watershed Approach, but implementation was like "going on a diet." In practice, it was difficult to do. The "Domino Approach" was a concept that the Office of Water used to simplify thinking about how to introduce the Watershed Approach, which requires a new way of thinking about delivering services to individual places, i.e., overcoming fragmentation of programs by thinking "what does an individual place need." Since there are so many watersheds and since many EPA programs involve states, the Office of Water selected the states as the initial "domino" to influence.

Dr. Geiser asked whether the Agency had considered developing a specific diffusion plan similar to the plan used to introduce pollution prevention technologies in Massachusetts. Ms. Wise responded that the Agency had a five-pronged plan that involved advertising, developing tools, providing financial incentives, reorienting EPA programs, and measurement/evaluation. She mentioned that the states generally resisted efforts to measure and evaluate their progress in applying the watershed approach. Dr. Kasperson suggested, in response, that a real diffusion plan would differ from a general communication plan or implementation strategy. It would identify specifics to be accomplished, stages and targets to reach (e.g., specific states, specific places and other "influentials" tagged as early adopters), barriers per stage, and an estimate of the resources and time involved. It would need peer review and discussion, and could be used, evaluated, and readapted as a living, dynamic plan. He suggested that planning the social process of diffusion could be as important to a project as planning the technical aspects of a project.

The conversation then turned to incentives for adopting or not adopting the Watershed Approach. Ms. Wise suggested that for some, the motivation came from the fear of future requirements or the desire to have a say in how they apply, avoiding future requirements, such as storm water regulations or requirements on animal feeding operations. EPA also provides some small amount of financial incentives. She suggested that the primary motivation comes from people's caring about clean water in their neighborhood.

Dr. Sim Sitkin then asked whether there would be a benefit in analyzing the states and the over 4000 watershed groups to determine factors relating to effective diffusion. He suggested that analysis may show that diffusion strategies could be different for different groups. Ms. Wise suggested that such a data gathering and analysis process could occur as part of the 11 regional roundtables occurring as part of the Clean Water Action Plan and the big national watershed forum envisioned for 2001. There will be a Watershed Report associated with the national forum; it might outline a diffusion plan.

Dr. Frances Berry returned to the question of incentives and measurement. She stated that her research shows that state and local governments are searching for models. She believes that personnel in state and local governments value and learn from high-profile award programs (e.g., JFK school innovation awards, ICMA awards). She suggests that EPA encourage watershed groups to apply for those awards because they will help provide the credibility needed and the detail about implementation experience that people at the local level are seeking.

Dr. Berry also suggested that effective diffusion of the watershed approach depended on giving local governments an understanding of how it relates to performance-based budgeting. She suggested that almost every state has adopted performance-based budgeting and that staff in state legislatures and state agencies are seeking outcome and output models. She proposed that if models are not readily available, EPA would benefit from investing in them. In the interim, EPA could suggest some generally accepted measures, and communicate them in an advisory, not mandatory way. She suggested that EPA write up and disseminate cases where performance-based measurement has been done. Dr. Dale Manty (EPA, Office of Research and Development) suggested that the brownfield program might offer cases where such performance measurement has been done. Dr. Mary Durfee added that, based on her experience with Lake Superior, it would be appropriate for the performance measurements for watersheds to address quality of life issues, not just water quality.

Dr. Sim Sitkin then suggested that analysis of the differences among watershed groups and among states may indicate different goals and different measures for different groups. He also suggested that different documents may also aid learning in organizations in different ways at different stages of the process. Some documents can capture learning that already occurred and transfer that information to others. Other documents are "living documents" that are scaffolding for enhancing capabilities and learning but the document itself is a "throwaway" and should not be confused with a reference document.

Dr. Laura Steinberg asked whether EPA might use crises strategically to advance innovations related to the Watershed Approach. She suggested that Agency might develop a plan to promote key innovations when major disruptions [perhaps even the introduction of "regulatory tsunamis" like the Total Maximum Daily Load (TMDL) rule] threaten to have major impacts and capture public attention.

Dr. Roger Kasperson concluded the session on the Watershed Approach by suggesting that the approach actually involved three or more different sets of innovations (e.g., community-based assessment, inter-jurisdictional cooperation, adaptive management), each in themselves difficult to

achieve. He suggested that it may be helpful to be clear that there are multiple innovations and that each one may have a different diffusion process. He proposed that it may be useful to "unravel" some of them, develop a separate diffusion plan for particular innovations as appropriate, identify different targets for different aspects of diffusion as appropriate, and measure the efforts separately.

2. Multi-Media Persistent Bioaccumulative Toxins (PBT) Initiative/Pollution Prevention. Mr. Thomas Murray began the session by summarizing the major diffusion issues he saw: (1) how to develop goals and measures in sectors where EPA does not have significant expertise in the technologies being used or the organizational structure; (2) how effective are case studies and pilots-- some people use them, others don't; (3) how best to get information out as part of a diffusion strategies; (4) how to work through the EPA regions and states; (5) how to achieve an appropriate balance of incentives and "scares" (e.g., use of the Toxic Release Inventory); and (6) how to work in a fluid process -- often EPA deals with an issue and a need for an innovation and doesn't initially have an innovation to diffuse (i.e., EPA's work with Dow's Midland Plant). He asked for advice on how to fight through some of these hurdles to develop and implement a diffusion strategy.

The discussion began with some clarifications and suggestions. Dr. Michael McFarland suggested that he had seen progress in the Department of the Army in its use of pollution prevention alternatives to CFCs. Dr. Karlene Roberts suggested that the Agency supplement its own limited resources in the behavioral and social sciences needed to understand business sectors by accessing the National Research Council Committee on Natural and Behavioral Sciences.

Dr. Kenneth Geiser advised that EPA develop an explicit diffusion plan that would model the setting, the social network and the context it wanted to influence. He suggested that such a plan could identify the points of intervention, give EPA some leverage, and allow it to be more effective in a reasonable time at a reasonable cost. He indicated that both OPPT and OW could develop such plans more aggressively.

He gave an example of how such a plan might work. In the replacement of PVC pipe in a blood bank, his research looked at how decisions about blood bags were made. He found that major decisions about purchasing were not made by individual firms. They were made by large conglomerates that negotiated and set prices. This research into organizations and complex purchasing behaviors changed the way his Institute thought of consumers. Decisions were being made in unsuspected ways. He suggested if such behaviors were not studied and modeled, the true process could not be known, understood, and planned for. He concluded that social sciences had a role to play.

Dr. Frances Berry followed this comment by suggesting that such practice was consistent with quality management. In the case of environmentally preferable cleaners, for example, it is key to interview purchasing officers to understand how they perceive quality and reality, and identify what they are most concerned about. To diffuse an innovation effectively, an Agency needs to highlight relative advantages in the terms valued by the target audience and to communicate benefits in empirical terms.

She suggested that recent work in political science suggests that change happens when three different streams flow together: (1) problem definition stream; (2) solution identification stream; and (3) political stream (e.g., elections and new administrations). Policy change occurs when a “window of opportunity” opens and all three streams converge. She suggested that EPA could highlight the problem stream more effectively. Dr. Sim Sitkin added that identifying the "resource stream" would complete the model and enhance the effectiveness of the diffusion plan.

Dr. Mary Durfee addressed the complexity of EPA's approach to pollution prevention; the Agency is attempting to diffuse innovations at different scales. It is doing this work without significant research into the social process of adoption. By contrast, the Department of Defense invested half a million dollars in the network analysis of the modeling of people influence in the adoption of a new computer system. This research resulted in new information that the Department of Defense is using to diffuse this one innovation.

Even given EPA's lack of resources for similarly intense, detailed research, Dr. Durfee suggested that EPA could be more strategic in its thinking about diffusion. EPA might consider identifying "structural holes," organizations like POTWs that exist at an intermediate scale. The key is to identify individuals or organizations who are located in enough networks so they can "jump back and forth," being influential among different groups.

She suggested that the Agency think strategically about organizations of different sizes. In her view, an organization with about 150 people might be an ideal diffusion target. It would be large enough to have the requisite expertise and resources to undertake innovations and yet small enough so that managers have real decision-making authority and that information would be integrated, not stove-piped. If the Agency were able to pick targets to influence of roughly that size, and if those targets were located strategically in multiple networks, and if the innovations were perceived as successes by the targets, then factors for diffusion would be most favorable.

Two EPA Staff people, Mr. Larry Weinstock (EPA, Office of Air and Radiation) and Mr. George Wyeth (EPA, Office of Policy, Economics and Innovations) suggested that EPA programs that focused explicitly on marketing (Green Lights Program and the Energy Star Program) had success in propagating particular innovations. Mr. Weinstock commented that the pollution prevention program both involved itself in identifying innovations and propagating them.

Dr. Sim Sitkin agreed with Dr. Durfee that the role of intermediary organizations was crucial and that it is important to understand who is making decisions relating to innovation and their motivation. Dr. Sitkin suggested that this insight may be useful to watershed efforts also. Working with intermediate target units may help to understand when it is appropriate to "smokestack," and when it is appropriate to integrate with the watershed approach.

Dr. James Dearing concluded the discussion of pollution prevention with some summary remarks. He cautioned the Agency against confusing a marketing approach with a diffusion approach. He argued that "taking an ad out" is not the same as diffusion. A marketing approach characterizes

potential "choosers" of an innovation as autonomous. The diffusion approach assumes a relationship among potential adapters--views them as inter-related somehow, perhaps as described in Everett Roger's model in Diffusion of Innovations--and seeks to use this knowledge of the social system in a conscious way.

The key is to identify who has decision-making ability, then to identify who is in communication with that person, and the person's social position within the networks. The strategy is to appeal to change agents themselves and influence them to influence others. He emphasized that if EPA identified the right people, it would be important to influence them in the right way. They could defeat innovation just as fast as they could propel the innovation.

3. Use of Social Science Tools, Cultural Profiling. Ms. Theresa Trainor began the discussion with a question about where the field was most fertile for introducing the Profiling Guide. She suggested that it might be most strategic to implement it externally, because most of the potential users in EPA would be non-social scientists, who would be learning something very new. She asked for advice identifying innovators and early adopters. She asked for advice on overcoming the barriers identified earlier and how to prioritize actions. She also stated that EPA intends to change the name of the tool from "Community Cultural Profiling Guide" to something like "Community Cultural Assessment Guide." Subcommittee members agreed that such a change was important.

Dr. Kasperson began the discussion with requests for clarification about the diffusion issue and potential users. Ms. Trainor responded that there was a need to diffuse both an awareness of the need for the guide and the specific tool itself and that potential users were likely to be unfamiliar and potentially uncomfortable with the Guide because of a lack of social science training. Ms. Trainor also suggested that the Agency had also asked two Native Americans to review the Guide and received feedback that other tools might be more useful to understanding tribal members' cultural attitudes toward ecological resources.

Dr. Dominico Grasso inquired whether it would be feasible to break the Guide into component parts and introduce it in a phased way that might be more attractive to users. Dr. Rogers suggested that such an approach would be consistent with the diffusion framework in his book, since innovations generally have a more rapid rate of adoption if they are compatible with ideas they are replacing. Small increments are likely to be more successful. Both Subcommittee members, however, acknowledged pitfalls. Sometimes efforts that succeed at small scale "fail miserably" when they are scaled up. Dr. Rogers added that innovations perceived as having high uncertainty are also perceived as more complex (and less desirable). Many highly uncertain innovations, however have high payoffs. This dilemma is one of the unique aspects of preventive innovations, such as the ones being discussed by the EPA.

Dr. Frances Berry suggested that it would be helpful to link introduction of the guide to values and utilities held by the target groups outside the Agency. She suggested it would be a useful tool for conflict resolution, community-based, natural resource planning, and strategic planning for groups like

"1000 Friends." If the Agency could link the tool to real practical issues faced by the target audience, diffusion would be enhanced.

Dr. Sim Sitkin suggested that diffusion externally seemed less difficult than diffusion internally within EPA, because externally EPA has developed a seemingly effective strategy of working through partners. Effective diffusion within EPA might involve consulting the literature on "communities of practice" within organizations. He suggested there was a body of literature on how to identify and work with cross-cutting groups with similar expertise and needs.

Dr. Karlene Roberts suggested that diffusion externally and internally might be enhanced by a case study write-up of implementation of a Guide that would appear in a journal read by environmentalists. Such a tactic might influence non-social scientists. She also commented that environmental sociologists and psychologists were likely to be very comfortable with the tool as a well-developed system that could be used in the field.

The conversation then turned to other targets for implementation. Dr. Laura Steinberg suggested that EPA's environmental engineers, especially those with recent training, would be interested in the Guide and would welcome the opportunity to be involved in its implementation. She also suggested that perhaps the tool may be useful to other federal agencies, whose staff might "sell" the effectiveness of the tool back to EPA staff. Dr. Durfee then mentioned that the Army Corps of Engineers has consciously invested in conflict resolution and appears to have the characteristics of an organization that learns; and might be receptive to the Guide. Dr. Roberts also suggested that it might be useful to the Department of Interior within the National Park Service and to the U.S. Coast Guard.

Dr. Roger Kasperson concluded the session by commenting that the Guide represents an interesting case of evaluating what success means. Introduction of the Guide involves a new tool and changes in practice, but the real measure of success may not be how many times the tool is used, but how helpful it is in problem solving. Effective diffusion may involve identifying opportunities to match the tool to the right problem, raising consciousness of the need for such a tool, and instituting the tool in the most effective way.

Public Comment.

Dr. Claude Bennett from the U.S. Department of Agriculture (USDA) was the only individual providing oral comments. He supplemented his written comments provided to the Subcommittee by describing USDA's efforts to integrate demonstration projects with research efforts so that users would be involved in the design of innovations intended for them. His program has discovered that farmers tend to adapt most and learn most from other farmers, in contrast to their reactions to research conducted at Agricultural Experiment Stations. In FY2000, USDA for the first time funded integrated projects spanning applied research, extension and evaluation. He suggested that designing innovations in such a way had great potential for diffusion and how programs evaluate the effectiveness of research.

Presentation on Diffusion of Environmental Innovations from EPA's Office of Policy, Economics and Innovations (OPEI).

Dr. Jay Benforado, Deputy Associate Administrator of OPEI gave a brief introduction to the role of his office. His office has the task of helping people at EPA see their job as continual innovation. He saw innovation at EPA as a priority because the Agency is facing new and different environmental problems from when the Agency began (e.g., non-point source pollution); has new tools (e.g., Internet); is working with new partners (e.g., new roles for states and local governments); and there are new paradigms that are alternatives to pollution control (e.g., pollution prevention, sustainable development, environmental justice). He suggested that EPA has in the past ten years generated many innovations. Some have been incremental improvements to existing programs and some been transformational (e.g., watershed protection, airshed trading). He wondered if there were on the horizon even more major changes that he called “step changes,” major innovations such as self regulation or regulation of whole facilities. He referred Subcommittee members to the recent publication, “Innovation at the Environmental Protection Agency; A Decade of Progress,” which documented programmatic changes (e.g., in Superfund and the brownfield program); new partnerships (e.g., especially in the areas of energy efficiency, water conservation); and the importance of stakeholder involvement. He introduced the manager of a new office within OPEI, which focuses on environmental policy innovations.

Ms. Betsy Shaw, Director of the Office of Environmental Policy Innovation, described her organization as having three divisions with responsibilities for innovative pilots, evaluation, and major policy and program change. One initial focus will be on scaling-up innovations resulting from Project XL, such as self-certification. Her organization will be developing criteria for diffusion; such criteria would include the power of the idea, how it relates to money, and a “gut sense of ripeness.” Her organization will employ a flexible strategy to engage Agency staff. The goal will be to keep good ideas alive, match them to problems that need to be solved and match them with key staff. OPEI will work with a cross-Agency Council of senior managers who form the Reinvention Action Council.

Next followed a discussion of how the SAB and the social sciences might assist the OPEI. Dr. Benforado stated that his organization could benefit from better understanding how to work with public service organizations and businesses in different sectors. He also saw a need for better understanding of how to work with the public and other partners in environmental protection. He also wondered whether there might be advice for the new Office of Environmental Innovation on types of innovations to focus on and priority steps to take, and how to promote innovations that cut across the activities of existing EPA programs. Dr. Kasperson thanked Dr. Benforado and Ms. Shaw for their presentations and offered the possible conclusion that the Agency is currently thinking more about innovation than diffusion. It may be time to establish greater balance.

Summary of Discussion and Identification of Next Steps.

Dr. Kasperson asked the group whether they would find it appropriate and possible to write a Commentary Letter to the Administrator regarding the diffusion and adoption of innovations. Dr. Geiser suggested that the group did have a major message to convey: that the Agency's commitment to innovation needs to be balanced by a commitment to diffusion and that diffusion seems less well understood at the Agency.

Agency staff responded that such a letter might be very helpful. Dr. Dale Manty requested that the letter indicate the level of resources that would "make a difference" in helping the Agency understand diffusion of innovations. Ms. Trainor suggested that it would be most helpful if the letter informed the Agency of what a "diffusion plan" might look like and how it would differ from a communications strategy.

The Subcommittee agreed to provide written input on the four general charge questions to Dr. Nugent by Friday July 7 and that any document to be developed would be written for persons who were not social scientists. Dr. Kasperson suggested that he and Dr. Nugent develop a proposed outline, process, and proposed writing assignments for the Commentary Letter and communicate the information to the Subcommittee members.

At 5:20 p.m., Dr. Kasperson adjourned the meeting.

Submitted by Dr. Angela Nugent, Designated Federal Officer

Approved by Dr. Roger Kasperson, Chair