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METHODS FOR THE STUDY OF "SPREAD EFFECTS"

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TABLE OF CONTENTS

INTRODUCTION..... 1

MATRICES..... 14

ABSTRACTS..... 18

BIBLIOGRAPHY..... 63

ANNEX A - INFORMATION INTERESTING BUT NOT RELEVANT..... 69

ANNEX B - OTHER USEFUL LITERATURE..... 72

METHODS FOR THE STUDY OF "SPREAD EFFECTS"

A major goal of AID projects is to influence the physical and social technologies of extended areas of the countries in which AID works. With its limited resources, it usually cannot bring innovations directly to large areas but must choose selected sites for intensive development. Nevertheless, the aim is always to test and develop the effectiveness of the demonstration projects under local conditions, and when innovations are successful, to expect them to spread to other similar localities. Bringing technological advances to a small number of villages or a few regions is not enough by itself. Successful implementation in the target sites must stimulate further adoption elsewhere, either through directed diffusion by the host government and/or other agencies, or by spontaneous adoption by the people themselves or by other means. The spread of AID projects is central to its mission.

In order to find out whether innovations that have been introduced into a country by an AID project have diffused to other locations, it is necessary to develop methods for locating and identifying "spread." The methods should be sensitive enough to identify not only direct replications, i.e., use of the same technology for the same purposes, but should also be capable of detecting modifications of the technology.

Two particular types of modifications are of special interest. One is process spread. In some cases the basic process of the AID-introduced innovation is adopted to other areas of life, e.g., villagers' structured

participation in decision making in an AID water project may lead to villagers' participation in decision making about schools, or the introduction of an assembly line for producing water pumps may be adapted to assembly line techniques for repairing roads.

The second type of diffusion is product spread. In these cases, the specific product introduced by an AID project is used for purposes other than those for which it was originally intended. An example is solar stoves introduced for cooking, which are used by local potters for firing clay ware.

If the true effects of AID projects are to be gauged, it is important to know more than the effects at the immediate target site. Ways have to be found to study diffusion of the products and practices introduced through AID to other localities and for other purposes.

1. Review of Diffusion Studies

In order to develop systematic methods for such AID evaluations, we reviewed the several literatures on diffusion of innovations, technology transfer, research utilization, and community studies. We were looking specifically for answers to three questions:

(1) How have researchers from the different traditions studied the adoption of innovative practices and products? What have been their general methods and approaches?

(2) Once researchers moved beyond studying adoption at an initial target site, how did they identify other locations as candidates

(3) for study? That is, what information did they rely on to specify further sites that were likely to have been influenced by innovation of the primary sites?

(3) How did they collect their data? What procedures and instruments did they use? Whom did they go to for information? What kinds of questions did they ask? Did they find "unobtrusive measures" to collect the requisite information without having to engage in original data collection?

2. Studies Examined

Several hundred books, papers and reports were examined. In addition, we talked to over a score of researchers and development experts. Most of the material we located had little of relevance to offer for our purposes. Although the literature is vast, and scholars from a wide variety of disciplines have been engaged in study of the diffusion of innovations and technology transfer, we found that much of the literature displayed the following characteristics:

(1) Much of it is concerned with theories and concepts of diffusion. Although the material is enlightening, it does not deal with methods and techniques of measurement.

(2) Empirical studies have concentrated on the adoption of the innovation at the original target site. This type of inquiry has been much more frequent than studies of the spread or contagion of innovations to other sites.

(3) When replication of innovations at other secondary sites is the subject of investigation, there has often been a directed diffusion campaign to encourage people at the secondary sites to adopt the innovation. Therefore, selection of which sites to study in order to detect spread effects has not been problematic: the researchers studied the sites exposed to the persuasion campaign. Data were collected in much the same way as in studies of original adoption. In fact, the whole research effort was very similar to studies of original adoption.

(4) In many other studies in which replication of an innovation was studied, the investigator worked from a known list of "later adoptions." This is particularly true for organizational innovations in the U.S. A government agency or private group had been promoting the innovation, and the promoters kept track of adopters through visits, information from regional staff, periodic phone calls, etc., in order to maintain an up-to-date list of users of the innovation. Again, the researcher did not have to confront the problem of selecting likely secondary sites. The identification of candidate sites had been done.

(5) The predominant mode of data collection about the adoption or diffusion of innovations has been the systematic population survey. Structured interviews have been conducted with samples of the population of interest to find out who adopted the innovation, when, and under what conditions. Sampling techniques have varied in their attention to randomization and representativeness, but sampling of some kind is common.

(6) In studies where the adopting unit has been an organization rather than an individual, the usual source of data is an informant in the organization.

We concentrated on studies done in developing countries, because much of the technological and social infrastructure that makes possible alternative data collection methods in developed countries is sparse. For example, studies in the U.S. sometimes make use of telephone interviews, mailed questionnaires, compendia of published data, review of records and documents, etc.--techniques which are often less applicable to areas in which AID works. Nevertheless, we also looked at a large number of U.S. studies to see if we could identify ingenious methods that might be suitable.

Among the disciplines that have contributed most to the diffusion literature are sociology (rural sociology, sociology of education, of health, of science, and of knowledge), economics, anthropology, geography, and psychology. Also involved had been science historians, scholars of "science and society," scientists concerned with special problems (e.g. the use of basic scientific knowledge in the development of innovations), people in marketing and advertising, scholars in the management field, and of course, specialists in development.

3. Insights from These and Other Fields

Because the literature we surveyed was dominated by studies of original adoption and, to a lesser extent, replication (i.e. implementation of the same innovation for the same purpose at another site, often after the intervention of a change agent), and because the predominant modes

of data collection were sample surveys and interviews with informants, we sought out any ideas that might extend the repertoire. We were particularly interested in (1) techniques for identifying locations to which innovative technologies or organizational arrangements might have spread by spontaneous contagion, and (2) ingenious means for collecting data about spread. These are some of the ideas that we found provocative. Some of them are pretty "far out," but might be worth developing.

3.1 Identifying Locations

3.1.1. Physical Tracers

The ideal mode of detecting spread would be akin to radioactive isotopes. The medical researcher introduces radioactive tracers into the human system which are then observable by radiation detectors. Obviously, no such procedure is available in the social world, but this represents an ideal model. In nuclear weapons supervision, sophisticated equipment monitors radiation levels in order to detect authorized and unauthorized production and testing. During the invasion of Mediterranean fruit flies, their "diffusion" was monitored by medfly traps set at widely dispersed locations. Such procedures do not have any obvious analogs, but for some kinds of innovations under some conditions, ingenuity might develop parallel methods.

3.1.2. Communication Trails

In order to hypothesize which additional sites are likely to learn/imitate/implement the focal innovation, it is possible to chart the "communication trail" of persons involved with the

innovation at the original site. Geographers have developed methods to measure the "mean information field" (MIF) of people, i.e. the distance or area within which inhabitants are in contact and receive information.* It charts the distance and direction that villagers take to market, for example, or the places at which fishermen put in to port. It seems possible that spread effects would follow the communication trails of local inhabitants.

Family contacts are another form of communication. Understanding kinship patterns and patterns of intrafamilial visiting would lead to hypotheses about spread effects of particular interest might be migration patterns to urban centers, and urban-to-rural communications among members of extended families.

Some people in every society move from place to place, taking information with them. Itinerant craftsmen, for example, may be a channel for spread effects or, in some societies, Buddhist monks or other clergymen. In highly developed technological societies, innovations often travel when professionals leave one job (e.g. in aerospace firms or NASA) and move to other industries. Similarly, in developing societies, workers may change locations and take along their recent knowledge of innovative projects or procedures.

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* See, for example, Richard Morrill and F.R. Pitts, "Marriage, Migration, and the Mean Information Field," Annals of the Association of American Geographers, vol. 57 (1967), pp. 401-422; R. Ramachandran, Spatial Diffusion of Innovations in Rural India, Mysore: Institute of Development Studies, University of Mysore, 1975; D.F. Marble & J.D. Nystuen, "An Approach to the Direct Measurement of Community Mean Information Field," Papers and Proceedings of the Regional Science Association, vol. 2, 1963, pp. 99-109.

Sometimes, communication trails are highly structured. Extension agents from the government agricultural ministry or the departments of education or health make scheduled visits to bring modern practices to outlying sites. Their routes provide hypotheses about the paths of spread.

The introduction of radios, newspapers, and other print media to villages may be the stimulus for spread, and thus help to identify sites for study of spread effects. Visiting journalists may carry news about innovations.

3.1.3. Attendance at demonstrations, "fairs"

People can learn about innovative projects by visiting the original demonstration site. It seems fruitful to keep records of visitors who come to get information about the project. If there is a cluster of visitors from a particular locality, that may be a logical site to investigate spread effects. Similarly, attendance at fairs or other events at which the demonstration is displayed and information dispensed may suggest interest. Records of the persons who request further information may help point to sites for study.

3.1.4. Snowball samples

Key informants are always a good source of information about spread. Once an informed source is located, he or she can be asked to name other people who know about the diffusion of the innovation. Snowballing from one informant to other people whom he/she names extends the network of information.

In organizations, people in one organization can often name other organizations that have heard about, considered adoption of, or implemented the innovation.

3.1.5. Parallel organizations

If the innovative project is a structural/institutional arrangement or practices, the obvious sites for spread are similar organizations. Thus, if the innovation is a reorganization in a port authority, spread can be investigated in other such authorities.

3.1.6. Back-tracing from chance observations

Often the first indication of spread effects comes to notice by chance. Someone stumbles across an application of the innovation unintentionally. In such cases, it should be possible to inquire how the new user happened to hear about the innovation--the source of information and the channels of communication. This is true not only in cases of replication but also for "process spread" and "product spread," where modifications have been made in the original project.

Once such information is collected, it becomes possible to look systematically at other users of the same channels of communications and other persons in contact with the same source. By getting data from such people, it should be possible to identify other sites to which the innovation has carried.

3.1.7. Theory and speculation

Not least is the utility of theory. Scholars have developed credible theories about the pathways of diffusion for different types of innovations and these can be exploited. Economists, for example,

suggest that diffusion of industrial process innovations depends on such variables as the profitability of the innovation for a firm, its slack resources, size, market share, etc.

Informed speculation can also be a source. People who are knowledgeable about a sector and a region may be able to identify the most likely sites to which innovations will travel.

3.2 Means for Collecting Data

In the accompanying charts, we list the six methods of data collection that we found in the literature: sample surveys, informant interviewing, ethnography, records/documents, observation/visual inspection, and aggregate statistics. Most of these require little elaboration, and in fact, a look at the studies entered under each category give a picture of how such sources can be used to study spread effects. However, on some points a few words may be in order.

3.2.1. The "pinch point"

In order to save the time, money, and effort that large-scale surveys and searches entail, it is useful to find a pinch point through which the relevant information must travel. For example, if all irrigation pumps have to be ordered from a single supplier or a small number of distributors, then the spread of those pumps can be tracked by gaining access to the records of the suppliers.

One of the studies that we reviewed contained a clever example of the pinch point technique. Coleman, Katz, and Menzel wanted to learn which physicians in a community adopted a new drug, when they

adopted it, and the characteristics that distinguished early from late adopters. Instead of undertaking a survey of physicians and relying on their (often faulty) memory about when they first prescribed the drug, they turned to pharmacists' records. From that source (through which all prescriptions must pass), they recorded the names of adopters, date of first adoption, and the frequency with which they prescribed the drug. The method was much less time-consuming than a survey and provided more reliable information. They also collected much background information about the physicians from published medical directions.

3.2.1. Aggregate data

For some types of innovations, aggregate statistics provide a measure both of the effectiveness of adoption (evaluation of the project) and of project spread. For family planning projects, for example, the birth rate of a community (after an appropriate time interval) indicates whether inhabitants are using the contraceptive methods. An examination of similar statistics in other communities to which the innovation is hypothesized to have spread will suggest whether residents in those sites have begun using contraception. Over a sufficient time period, birth statistics can provide indications of the temporal and spatial distribution of the innovation.

For innovations involving hybrid seed, fertilizer, irrigation, and/or related practices that are expected to increase crop yields, statistics on aggregate yield can provide similar indicators. They suggest (without, of course, "proving") when and where the innovative practices have been implemented.

3.2.3. Records

Records, documents and already collected data probably represent the most underexploited source of information on spread effects. Although it is impossible to give explicit guidance about which records, documents, and previous surveys will be fruitful sources for the many different kinds of AID projects around the world, it is perhaps well to suggest that attention be given to records, including AID and mission records and that careful procedures be instituted to locate records and protect documents from "institutional memory failure."

4. Purposeful Omissions

We looked very carefully at several landmark studies in two areas: (1) the scientific origins of technical innovations and (2) the use of social science research and evaluation for policy making. These are extremely interesting and provocative studies, but they do not seem relevant (or transferable) to the measurement of spread effects.

Three extensive studies (and many smaller ones) have been done on the application of scientific research to the development of new technologies. The outstanding studies are Project Hindsight (on weapons systems), the ITT Traces Study (on the contraceptive pill, matrix isolation, video tape recorder, magnetic ferrites, and electron microscope), and Battelle's study on the Interactions of Science and Technology in the Innovative Process (on the heart pacemaker, hybrid corn, hybrid small grains, Green Revolution wheat, electrophotography, input-output economic analysis, organophosphorus insecticides, oral contraceptives,

magnetic ferrites, and video tape recorders). Despite the interest of the methods and findings for many purposes, they do not seem to advance our quest.

The work on the applications of social science researchs and evaluation to policy making has somewhat more relevance. One of the significant fundings by Weiss, Caplan, Patton, and others is that it is the generalizations and ideas from research that influence policy, much more than specific empirical findings from particular studies. This conclusion to some extent parallels Everett Roger's recent emphasis on the "re-invention" of innovations, i.e. the many modifications that are made both in the innovation and in the adopting organization during the process of implementation. But again, the studies do not contribute directly to methods of studying spread effects.

5. Process Spread and Product Spread

We found extraordinarily little in the published literature about process spread or product spread. Nor did the many experts with whom we spoke know about relevant materials. Even the NASA and NSF efforts in technology transfer, which we expected to provide important lessons, proved to have little to offer.

We have located two forthcoming studies, one in progress and one in the planning stage, that may (or may not) turn out to be relevant. The further exploration of these areas represents a task yet to be done.

Carol H. Weiss
September 26, 1981

I. Original Adoption

	Agriculture	Health, family planning and nutrition	Institutional managerial arrangements	Other social technologies	Other physical technologies
Single survey	1. Sandhu & Allen (1974); Choudhary & Maharaja (1966); Rogers et al (1970)	2. Aleys-Montalvo (1957); Junghare & Roy (1963); Wellin (1953); Chandrasekayan & Hermalin (1976); Logan (1973); Berelson & Freedman (1964)	3. Concran (1967); Evans & Black (1967)	4. Schuman (1967)	5. Arndt (1967); Obibuaku (1967)
Informant interviewing	6. Rogers et al (1970)	7. Wellin (1953); Logan (1973)	8. U.S.A.I.D. (1980)	9.	10. Obibuaku (1967); Feller et al (1974)
Ethnography	11. Eisendel (1968)	12.	13.	14.	15.
Records/ documents	16.	17. Chandrasekayan et Hermalin (1976); Berelson & Freedman (1964)	18.	19. Anello (1966); Ching-Ching et al (1974)	20. Obibuaku (1967)
Observation/ visual inspection	21. Rogers et al (1970)	22. Wellin (1953); Logan (1973)	23.	24. Agnew & HSU (1960)	25.
Aggregate statistics	26.	27. Chandrasekayan & Hermalin (1976); Freedman & Berelson (1964)	28.	29.	30.

Best Available Document

II. Replication

	Agriculture	Health, family planning and nutrition	Institutional managerial arrangements	Other social technologies	Other physical technologies
Social survey	1. Ryan & Gross (1943); Coughenour (1964); Fliegel & Kivlin/ 1966a, b); Sawhney (1967); Ramachandian (1975)	2. Deutschmann, Mendez Herzog (1967); Dubey & Choldin (1967); Coleman et al (1959a)	3.	4.	5. Raper & Tappan (1943)
Informant interviewing	6. U.S.A.I.D. (197)	7. Becker (1970a)	8. Yin (1978)	9. Yin (1978); Frontalich (1979); Rogers et al (1979)	10. Mansfield (1963)
Ethnography	11. Dobyns (1962)	12. Chandra (1964)	13.	14. Chandra (1964)	15. Chandra (1964)
Records/ documents	16. Ramachandian (1975)	17. Coleman et al (1959a)	18. Simon & Goloambo (1967)	19. Rogers et al (1979)	20. Mansfield (1963) Davies (1979)
Observation/ visual inspection	21.	22. Bradshaw & Mapp (1972)	23.	24. Rogers et al (1979)	25. Raper & Tappan (1943); Whyte (1954)
Aggregate statistics	26. U.S.A.I.D. (1980) Ramachandian (1975)	27.	28.	29.	30.

III. Process Spread

	Agriculture	Health, family planning and nutrition	Institutional managerial arrangements	Other social technologies	Other physical technologies
Sample survey	1.	2.	3.	4.	5.
Informant interviewing	6.	7.	8. World Bank (1976)	9.	10.
Ethnography	11.	12.	13.	14. King (1965)	15.
Records/ documents	16.	17.	18.	19. Anello (1966)	20.
Observation/ visual inspection	21.	22.	23.	24.	25.
Aggregate statistics	26.	27.	28.	29.	30.

IV. Product Spread

	Agriculture	Health, family planning and nutrition	Institutional managerial arrangements	Other social technologies	Other physical technologies
Social survey	1.	2.	3.	4.	5.
Informant interviewing	6.	7.	8.	9.	10.
Ethnography	11.	12.	13.	14.	15.
Records/ documents	16.	17.	18.	19.	20.
Observation/ visual inspection	21.	22.	23.	24.	25.
Aggregate statistics	26.	27.	28.	29.	30.