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U.S. A.I.D.'s ROLE AS AN INTERMEDIARY IN THE TECHNOLOGY TRANSFER PROCESS: MODELS, ASSUMPTIONS AND ISSUES

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U.S. A.I.D.'s ROLE AS AN INTERMEDIARY IN THE TECHNOLOGY TRANSFER PROCESS: MODELS, ASSUMPTIONS AND ISSUES

Background:

The Center for Development Information and Evaluation,PPE/CDIE, is undertaking a study of technology transfer within AID and its recipient countries. To this end PPE/CDIE is undertaking three activities; (1) A workshop was conducted July 17-18 to examine the process by which AID has sought to promote technological change in the host countries. The workshop brought together Agency staff with diverse experiences and sector responsibilities. The output of the workshop will inform the next two steps. (2) A contractor has been selected to review and analyze unclassified AID documents and AID commissioned studies on technology transfer. A paper will result describing the models and assumptions used to define and evaluate technology transfer and the issues involved regarding the Agency's role as an intermediary in the technology transfer process. (3) Undertake a series of project impact evaluations on the topic of technology transfer based on AID's experience.

The overall project is important in clarifying and evaluating the experience of the Agency. These efforts are timely in that the Administrator is writing a policy paper on the subject and there is growing concern and discussion over AID's effectiveness in technology transfer and its role in promoting and applying capital saving technologies.

Goal:

The goal of this paper is to understand the models and assumptions used to define and evaluate technology transfer. This understanding will assist the Agency in establishing fundamental operating principles to be used in planning and implementing technology projects and as a set of criteria for evaluating completed projects. Understanding the technology transfer process better will allow it to be harnessed and utilized for development purposes.

Purpose:

To provide a language for discussing the models and assumptions used to define and evaluate technology transfer and to identify the issues surrounding the Agency's role as an intermediary in the technology transfer process.

Assumptions:

The writers of this paper believe that important issues involved in AID's technology transfer experience cut across geographical regions and sectors. Generic, cross-cutting issues and definitions of technology transfer are possible whereby lessons can be learned which are applicable to present and future Agency policy formation, project design and implementation in general. Though each specific area of technology such as health, agriculture and water have their own unique problems, there are numerous common denominators and operating principles in technology transfer.

Approach:

The following analytic review of the Agency's recent documentation and experience is based on the following approach:

Review and analyze selected unclassified AID documents and AID commissioned studies on technology transfer including:

- Selected Impact Evaluation Reports,
- Special studies (E.G. on capital-saving technology),
- Draft policy documents,
- Other background studies, and reports relevant to the topic.

Interview program managers and former field personnel to determine assumptions, expectations and experience in this area.

Attend the workshop as a participant to discuss the key issues identified and to incorporate the findings of the workshop into the paper.

THE IMPORTANCE OF TECHNOLOGY

Technology has emerged as the common denominator for nations seeking economic and military power. The international transfer of technology has consequently assumed unprecedented importance in the aspirations of industrialized and developing countries alike. Economic development is tied to utilized technology. Technology is the technical means for doing things better, faster, more reliably or cheaper. New technology can be an effective agent of change. The introduction of a technology can become the catalyst for a better life for greater numbers of people than previously available under older technologies. But the exact role of technology in the economic development and the causal linkages are not precise because of the many non-technological determinents of economic progress.

THE TECHNO-ECONOMIC INTERFACE

It is important to distinguish the stages between a science and a technology base which can provide the foundation for development and the actual economic progress. The science and technology base of a country, if it is to contribute in any significant way must be effectively coupled to the demands of the economic sector. The interface between the science-technology base and economic progress is a complex one buffered by strong social, economic and political currents. Exhibit 1 places in perspective the principle elements of the techno-economic interface.

The existence of a large science-technology base has little benefit unless it is implemented and integrated with the socio-cultural environment strengthening the economy and improving the quality of life. Even the most important breakthrough will have little impact on lives in the developing nations unless it is put to use. Putting an idea to use is a complex process combining the new idea with the skills of entrepreneurship, management, marketing and finance. In order to implement an idea, barriers that act to impede the process must be overcome or minimized.

Technology transfer is the process of overcoming these barriers and integrating them with the desired productivity growth and economic

progress. Of the four principal elements for economic growth illustrated in Exhibit 1, perhaps the least recognized and appreciated is technology transfer. Demands for technological products and services will continue to expand in the face of strong competition for the S&T dollars. The information explosion will be exacerbated. All these factors will make the conscious transfer and effective use of available technology even more compelling and too important to leave to chance if strong rates of economic growth are to be created and sustained.

THE TECHNOECONOMIC INTERFACE

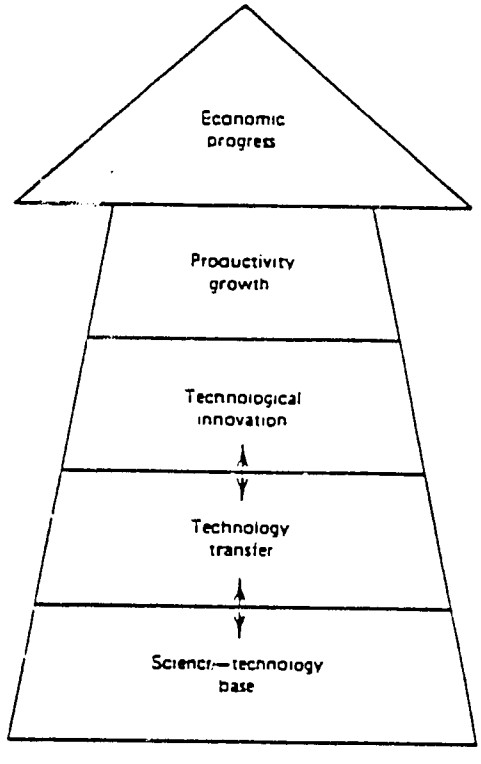

Exhibit 1

The first major consideration of technology transfer involves the linkage between available science and technology and the ultimate goal of economic progress. Technology transfer is a mechanism or process that integrates available know-how by focusing on needs/problems in the marketplace or society. As we shall see in analyzing the assumptions and models of technology transfer, "Technology Transfer" too often becomes an end in itself. The values and goals of economic "progress" become intermingled with the actual mechanism of technology transfer.

Technology transfer as a separate phase of development provides opportunities for employing proven technologies rather than relying solely on internal R&D of the country or company to satisfy technological needs. The use of external sources of technology tends to shorten the innovation time. Technology transfer also holds the promise of stimulating new ideas and innovations. The culmulative effect is the ability to recycle technologies for new uses and applications saving resources normally dedicated to new technology creation and making more effective use of the science-technology base.

TYPES OF TECHNOLOGY

"Technology" in this paper is defined to include both process and product oriented technologies, and to cover the entire spectrum from "soft", such as social marketing or training, to "hard" technologies embodied in product and equipment sales.

According to writers like De Gregori the central unifying characteristic of technology is its basic function as a problem solving process. This problem solving process involves tools and the skills and ideas necessary to employ the tools. Thus technology (human tool using) is an ideational process used to transform the material and non-material world. With the broad definition of technology and its emphasis on skills one is quickly brought to the realization that technology is a behavorial process that is transmitted through culture and as such becomes an integral part of organizations and institutions. The change process implied in the transfer of technology means that it is not merely the movement of things but of behaviors and world views.

In assessing a technology it is important to understand the level of integration with the behavioral and cultural aspects. Vernon Ruttan in his paper on "Technology Transfer, Institutional Transfer, and Induced Technical and Institutional Change" discusses technologies in terms of their "closed system" quality. The relatively "closed system" of many technologies, means that behaviors they require are quite particular to their operations - and not the socio-cultural system at large. Where there is no closed system technology, as in community development efforts, effective institutionalization may be difficult to achieve. In discussions of technology one encounters "institutions" viewed as a package of behaviors and relationships that describe a particular organization and its interaction with its environment. In implementing new technologies one moves from the engineer's perspective of technology as equipment into the behaviorial and institutional building aspects of technology transfer.

In understanding types of technology it is important to identify its level of development e.g. is it a mature or embryonic technology. Technologies that are beyond the proof of concept or demonstration stage have fewer engineering variables to overcome. Technologies that are beyond the laboratory stage makes transfer between similar cultures easier. Ironically, mature and packaged technologies may have a great deal of difficulty in transfer between dissimilar cultures. Even a piece of equipment has embodied in it the behavioral approaches unique to the developing culture. A country like Japan has been a master at separating the actual hardware from the cultural and behavioral aspects embodied in it. With this ability technology transfer is accelerated because behaviors appropriate to the receiving culture can be substituted. The type of technology will obviously influence the type of transfer required.

TYPES OF TECHNOLOGY TRANSFER

It is analytically useful to distinguish types of technology transfer. But before we outline different authors' views of technology transfer it would be useful to distinguish it from resource transfer. An unifying theme in many AID programs is that it is involved in resource transfer. Resource transfer can be defined as capital and commodity assistance. Erikson in his paper "Technology Transfer and Resource Transfer in a Country Setting" states that resource transfer ranges from "(1) project assistance intended to build the physical capital infrastructure of a country, such as a dam or field-to-market road system; to (2) assistance in the form of one or a few specified productive inputs, such as fertilizer, farm implements, or medical supplies; to (3) a range of imported inputs not tied to a specific project ("program" as opposed to "project" assistance); to (4) financing which enables developing country farmers or businessmen to purchase inputs, such as a small farmer credit program; to (5) consumption goods, such as

food provided through PL480 or contraceptives provided through family planning." Though a resource transfer may have a technological impact its primary objective is not to induce an adaptive response on the part of cultural,political, and economic institutions to realize the growth potential opened up by the imported commodity. Generally in resource transfers there is a one-to-one relationship between a problem and the resources or goods to satisfy the problem. Resource transfers address basic human needs and the humanitarian requirements of donor organizations.

Technology transfer can be defined in terms of its objective of intervention and induced change. The purpose of technology transfer is to increase innovations which directly impact the economic development of the country through "improved" techniques or equipment.

Technology transfer has been defined in various ways by various authors. For example Erikson defines it as the "provision of "know-how" or expert advice and training by AID to a recipient country, its people and institutions.Other directly associated costs are also included, such as vehicles and equipment required for use by technical experts." In this context technology transfer becomes "technical assistance" through the provision of experts and training. Though this definition neatly fits into existing programs of AID the definition limits a fuller comprehension of the technology transfer process and its potential.

Vernon Ruttan provides a typology of technology transfer. The three phases of international transfer of technology involve:

> Material transfer - is the simple transfer or importation of new materials such as seeds, plants, machines or management practices associated with these materials. Local adaptation by institutions is only a minor requirement. The analogy of material transfer in industrial technology transfer is the "turn-key" plant.
>
> Design tranfer - is characterized by the transfer of information in the form of blue prints, formulas, books and related software.

Design transfer involves animal breeding stock, plant materials or prototype machines imported for testing purposes, to obtain genetic materials or to copy or adapt imported designs. This area emphasizes the adaptation of the imported item or information to local conditions or to different tasks.

Capacity transfer - is the transfer of scientific and technical knowledge and capacity with an objective being to institutionalize local capacity for invention and innovation. From an agricultural perspective plant and animal varieties are developed locally to adapt them to local ecological conditions.Machine design becomes less dependent on prototypes developed elsewhere.

From this perspective, much of the institution building effort of AID can be viewed, and evaluated, against the objective of speeding entrance of the LDC's into the capacity transfer stage. For Vernon Ruttan, under modern conditions technology transfer is increasingly dependent on capacity transfer.

From a historical perspective on the generation of technology, Thomas De Gregori makes a similiar distinction. De Gregori points out the difference between technique transfer and technology transfer. He states,"Transferring an improved problem solving technique is only the initial characteristic of technology transfer. If this is the extent of the effort, it is, then, technique or tool transfer, and not technology transfer. Technology transfer only occurs when the new technique is integrated into the recipient culture and is simultaneously linked to the dynamics of the international technological system that brought it into being." De Gregori requires in his definition of technology transfer the capacity to give rise to future dynamic accelerating development. Under this model, science transfer must accompany technology transfer if it is to take root.

The definition of technology transfer as the creation of a science and technology infrastructure is attractive from a number of standpoints. From AID's perspective this type of definition justifies the creation of public sector research and extension services as well as continues the government to government interactions. From a historian's view of centuries and macroeconomic trends there does tend to be a correlation between

science and technologies in use. From this idea of development and definition of technology transfer it follows that in order to spur productivity and economic development by means of technological change, greater investments in research and development and its institutions are required.

On the other hand, major criticisms of AID's programs focus on the lack of effective implementation and integration of new technologies into the developing economy. The implication ,therefore, is that R&D investment may not be closely correlated with the introduction of new processes and products. This is a major hypothesis that must be tested during the impact evaluations. It may be found that technological change does not automatically translate into productivity growth but is only one contributor to a complex process by which innovations are introduced into the developing economy. The path from R&D investment to productive output is typically a long and arduons one, lasting many years, There is no assurance that the technical knowledge base resulting from R&D and institution building will be effectively applied towards greater economic and social development in the form of new and better products and processes. When pressed on how the technology is actually transferred advocates of technology transfer as creating a better S&T base refer to the "invisible hand" of self-interest and the marketplace. The lack of specific information on the actual technology transfer process does not provide assistance in developing effective approaches to maximizing AID resources.

Increasing the scientific and technological activity in a country does give rise to the science and technology base that is the total accumulation of technical knowledge and resources developed. (Reference- D.F. Koeppe, Technology Transfer - Theory and Applications, Twenty first Century corporation, Texas, 1977) The science-technology base is dynamic in that it is continually changing and growing as a result of scientific and technological advances, otherwise known as technological change. Technological change is the incremental improvement made in the science-technology base. It encompasses scientific advances, wider engineering know-how, availability of better materials, improved industrial processes

and more efficient design techniques. Technological change is the incremental upgrading of the existing pool of knowledge and accepted practices in the technical field. Technological change can, but does not have to affect the bottom line of productivity improvements.

Several structural factors must be analyzed when evaluating the effectiveness of resources being placed into "capacity" transfer or S&T development. A low significance of R&D and infrastructure development could be reflected in the differences in the characteristics and motivations of the innovator and the researcher. The innovator typically exhibits entrepreneurial qualities requiring a breadth of knowledge in different fields whereas the researcher possesses in-depth knowledge in a specialized field. (Reference- P. Jervis, "Innovation and Technology Transfer - the Roles and Characteristics of Individuals," IEEE Transactions on Engineering Management, EM 22 (Feb 1975)). The innovator uses available knowledge as much as possible, while the researcher pursues the generation of new knowledge. The innovator generally exhibits a high degree of creative ability. In contrast, creativity appears to have no direct relationship with manifest research competence. (Reference- P.E. Conner, "Scientific Research Competence as a Function of Creative Ability, IEEE Transactions on Engineering Management, EM 21 Feb 1974). The innovator is strongly motivated with the promise of commercial success. On the other hand, the ability to pursue one's reseach interests coupled with the peer recognition associated with research achievements are the prime motivational forces for the researcher. The output of science is usually publication of results. These distinctions, however, become less clear for those participating more in applied research and development. Nevertheless, they serve to illustrate the differences in the basic behavioral characteristics and motivations of innovators and researchers that contribute to the low impact of S&T institutions and R&D on the innovation process. The question of "Who has responsibility for the effective implementation and transfer of the technology?" becomes increasingly important.

A structural problem area with the emphasis on S&T institution development is that projects tend to have technology push as its orientation. Difficulties are encountered when innovations are developed from predominately technological considerations without adequate knowledge of the potential market demand. Innovations created in response to recognized needs are necessarily market oriented instead of technology-oriented. Consequently they tend to gain more rapid acceptance in the user community. These innovations are normally pursued with an eye toward market introduction at the earliest possible date because of the transitory nature of market demand, the rapidity with which technological obsolescence develops, and the opportunity to scoop the competition. The "window of opportunity" and the flexibility required to introduce a new product or process many times cannot be properly addressed by public sector S&T institutions. As a result, much of the early effort during the innovation process concerns the search for relevant information and the application of existing technology rather than in the conduct of research.

A study of the numerous studies on the innovation process would be helpful in identifying those factors most commonly associated with successful innovations. The picture that emerges is one that points to the clear importance of being attuned to the market environment. Though the majority of studies on innovation involve the industrial aspects of innovation as well as governmental agency involvement a major conclusion drawn from these studies is that roughly three out of every four successful innovations are stimulated from need recognition, while the remainder are initiated from the availability of technical opportunities. (Reference- numerous studies but in particular J.M. Utterback, Innovation in Industry and the Diffusion of Technology" Science 183 Feb 15, 1974) That is, demand pull rather than technology push is the more important stimulus in most cases of successful technological innovations, This is not to imply that idea conception and research are unimportant in innovation, On the contrary, they could play crucial roles throughout the different stages of the innovation process to the extent that the innovation could otherwise fail without them. The point is that need recognition is the most important,

factor in starting innovation, while the other factors could be important at any stage of the innovation process.

An evaluation of AID's invovlement in technology transfer should focus on the conditions for technology transfer such as S&T institutions ; however, the evaluators should realize that many conditions for technology transfer may be necessary but not sufficient for the actual implementation of the innovation. If projects can be identified the actual process of technology transfer should be analyzed and not merely the conditions for it.

INITIAL DEFINITION OF TECHNOLOGY TRANSFER

What is technology transfer? Simply put, technology transfer is the application of technology to a new use or user. It is a process by which technology developed for one purpose is employed either in a different application or by a new user. Technology transfer is a problem solving process involving principally the increased utilization of the existing science-technology base in new areas of application as opposed to its expansion by means of further R&D. It is a vehicle or means by which elements of the existing science and technology base, wherever it exists, can be more closely linked to the innovation process in order to spur economic growth.

Technology transfer involves a unique combination of technical and institutional change. It is an intervention into a preexisting system of technologies and beliefs. It involves an adaptative response on the part of cultural, political and economic institutions to realize the growth potential opened up by the new technical opportunity. An essential aspect of the definition is that technology transfer only occurs when the improved ways of performing a task or employing a technique are adopted and integrated into the recipient economic and societal system.

A variety of means are available to transfer technology depending on the nature of the technology and the specific circumstances prevailing in each case. Lessons for the public sector involvement can be learned from the methods employed by private firms; however, newer models must be developed. Methods for the private sector range from licensing agreements, joint ventures and turn key factories to technical consulting, and trade exhibits. No single method for the private sector is appropriate for all situations. The effectiveness of the different approaches in the private sector differs in terms of the ability of the technology recipient to learn and to acquire increased technological know-how. This observation, if it held true in the public sector, would mean that the focus on the poorest of the poor will result in fewer successful technology transfers. Generally, those methods of technology transfer involving considerable person-to-person contact and

some measure of education and training are considered the more effective approaches. Successful technology transfer therefore hinges, to a large extent, on whether effective communications is developed between the principal parties. The maintenance of effective communication channels both internal and external to the organizations is necessary to help assure the timeliness of the information flow.

MODELS AND ASSUMPTIONS BEHIND U.S. AID'S USE OF "TECHNOLOGY TRANSFER"

A major problem arose in discussions with AID personnel and in review of the literature on technology transfer because of the differing conceptions. Conceptual clarity on the subject has been hampered, ironically, by the administration's emphasis on technology transfer as a platform for change. The latest policy emphasis and its surrounding buzz words have become an algebraic variable whose defination changes with the speaker or institutional setting. The words"technology transfer" are placed where other words and concepts were traditionally used. What was once an infrastructure development project is now renamed a technology transfer program. Unfortunately, "technology transfer" has become a value-laden word which obscures the actual process. The following section will attempt to arrange the myraid of approaches into three major organizing concepts. Each of the organizing concepts will be broken down into three "schools" of thought. This section will end up with the most current definations used for technology transfer.

Exhibit 2, entitled,"Development of AID's Concept of Technology Transfer", outlines various approaches used in the Agency. Both interviews and an analysis of AID documents have been useful in creating these organizing concepts. Though there are overlaps, the sequencing in the exhibit provides a rough idea of the concept within the Agency. It is interesting to note that though certain concepts existed earlier than others, adherents of all schools can be found in the Agency can be found. In the evaluation of technology transfer projects and in the design of Agency policy it will be inportant to realize the models and assumptions used by individuals and Divisions as they use the term.

DEVELOPMENT OF A.I.D.'S TECHNOLOGY TRANSFER CONCEPTS

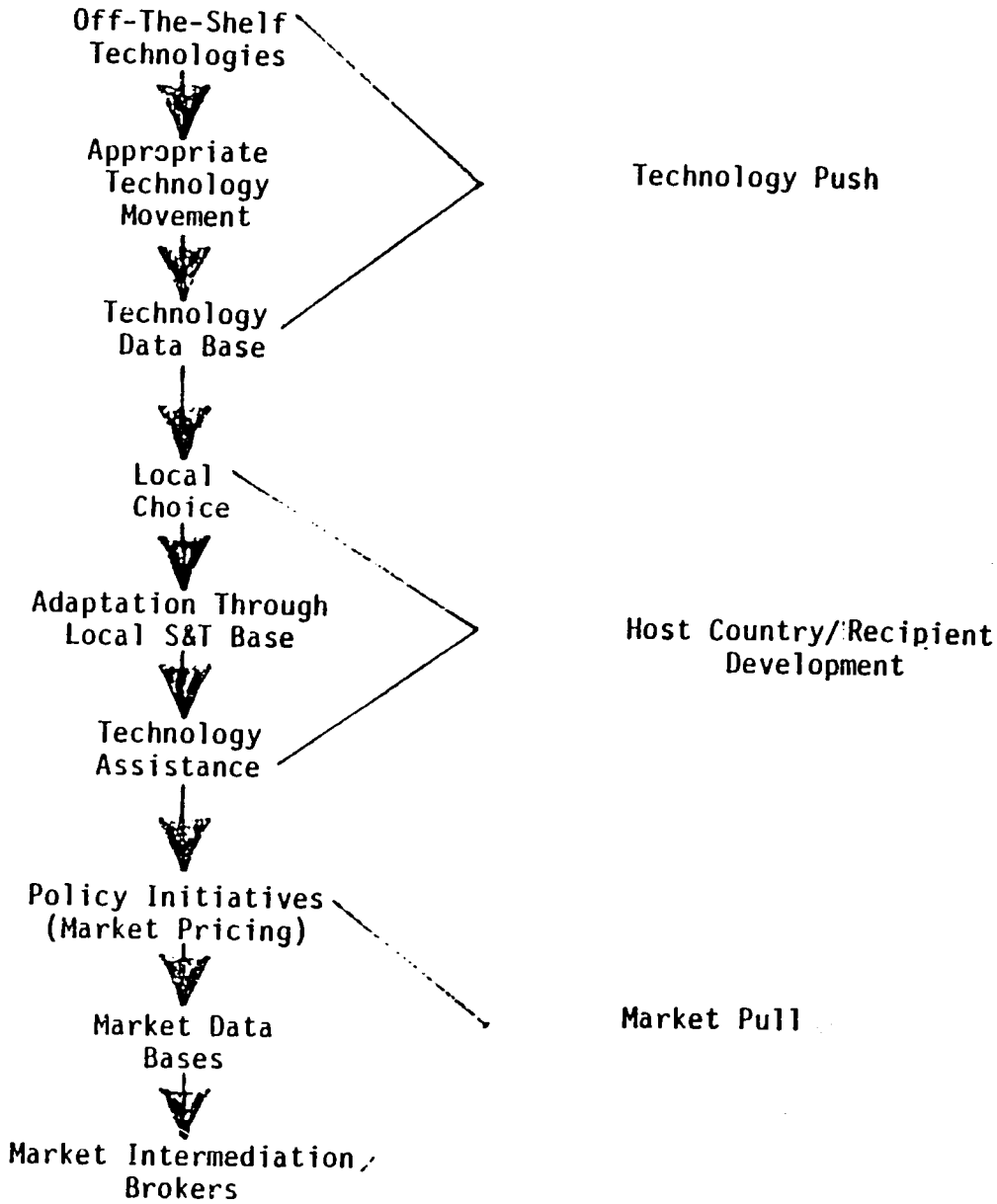

EXHIBIT 2

As project experience accumulates over the years, there has been a growing realization of new priorities and solutions. This dynamic system within AID testifies to the importance of evaluation and feedback to chart newer directions for resource allocation and management. "Technology transfer" and its development are part of this dynamic process. Therefore we cannot say that the varying definitions are a result of confusion but are part of the development of U.S. AID itself.

A major assumption within the Agency and its previous organizations that lead to the importance of technology transfer was the realization that technology can be a powerful agent for change and economic development. Resource transfer and physical infrastructure development are important means;however, neither approach allowed the country to master the tools of development-technology. The development of AIS's concept of technology transfer spans the past twenty five years. Over this period of time the emphasis has moved from the technology itself as embodied in the technology push approach to the recipient country emphasis on developing its own capability to create technologies to the emphasis on intermediaries and market indicators as a means to transfer technology.

Approach #1 - Technology Push

The first organizing concept and the earliest to appear at the Agency canbeclassified as - Technology Push. The focus of the Technology Push approach is its emphasis on the technology itself. America's technologies were seen as the answer to the problems facing the LDC's.

The school of thought first identified in the literature on technology transfer can be classified as "off-the-shelf". It was difficult to find these early documents within AID but an analysis of Congressional speeches of the early '60's reveals that the answers to the world's problem already was developed and

development of a LDC was merely a matter of getting the technologies off-the-shelf. This school was born of an era when America had the only color television sets, the only commercial jet aircraft and the highest standard of living. When the only source of technological excellence was the U.S. then those who wanted to transfer technology would come to the source. Questions about marketing the technology or its implimentation in a foreign context were not identified problems. This school emphasized that it is easier to transfer western technologies than to develop new technologies in LDC's. The emphasis in the late '50's and '60's on every country having their own steel plant could be seen as part of the "off-the-shelf" school.

The undoing of the "off-the-shelf" school's popularity rests with its previously unidentified assumptions based in western technology. Western Technology emphasizes labor saving means and is capital intensive. The capital intensive work may be appropriate for large scale fertilizer plants but that approach did not address the needs of large numbers of people in developing countries held back by the limited productivity of traditional work methods in conditions of extreme poverty. No longer could a development agency solely emphasize the delivery or design of mechanical devices.

As project experience accumulated there was an increased realization among government agencies of the need for technological solutions responsive to the problems of LDC's and appropriate to the local mix of resources. Technology transfer was defined in the early 1970's as "appropriate technology". Appropriate technology emerged as a technique of economic development and as a supplementary approach to development assistance. AID's legislative mandate for appropriate technology was created in Section 107 of the International Development and Food Assistance Act of 1974 (Public Law 94-161), which outlined an expanded private effort to promote appropriate technology. AID action resulted in AT International being created as an institute to undertake independent projects in the development of appropriate technology.

Even before the legislative mandate to direct programs and funding toward appropriate technology projects there was a growing realization of the failings of defining technology transfer as obtaining existing technologies "off-the-shelf". The Report of the House Committee on International Relations presented the rationale for AID's charge to promote appropriate technology:

> "The experience of more than a quarter of a century of development assistance programs overseas has clearly demonstrated that much of the technology used in the United States and other industrialized countries is not well suited to the economies of development counties. It is too big, it is too expensive, and it does not create the jobs needed to absorb rapidly expanding labor forces in countries which already have an abundance of labor. It is not appropriate for use on the very small farms and in the very small business enterprises that make up so much of the economic activity in the developing world."

No single comprehensive term or definition is accepted as the sole description of appropriate technology. Throughout the interviews and in reading the material published by AID and its contractors many terms are applied to the similiar concept. Appropriate technology is called intermediate technology, labor intensive technology, self-help technology, village technology, user-oriented technology and alternative technology. A major sub family of concepts and terms favored in many AID documents is defining appropriate technology as capital-saving technnology (a term promoted by Rep. Clarence Long). In March, 1981 AID provided official guidance and a definition of capital saving technology that read as follows:

> "Capital-saving technology in the production of manufactured and agricultural goods and services in developing countries <u>combines</u> labor and capital in accordance with their relative prices and scarcities; <u>involves</u> the local community in adopting new technologies and in participating in cooperative credit, savings and loan, and extension services; is <u>physically accessible</u> to the poor since it is modest in scale, simple to install and durable in operation, is <u>financially access-</u>

ible by means of small per capita investments which reach small producers; and is locally maintainable, that is to say, capital-saving technology can generate self-sustaining and self-financing growth in the low -income sector." (Development Experience Reviews, Volume one - Appropriate Technology, 1981)

AID has provided a summary definition: " In terms of available resources, appropriate technologies are intensive in the use of abundant factor, labor; economical in the use of the scarce factor, capital and highly trained personnel; and intensive in the use of domestically-produced inputs." A problem with this definition as well as others is that the concept of appropriate technology has so many approaches and components. No single grouping of criteria can precisely separate appropriate technology projects from other development projects. Appropriateness is the key - and what is appropriate depends on the circumstances and the value system of the donor and recipient. In much of the literature the use of appropriate technology should achieve the most lasting benefits with the most effective use of available human and material resources. It is very difficult to argue with these ideals. In this context appropriate technology is equated with economic progress. As would be expected many different groups with conflicting values systems were grouped under this umbrella. The results of actual projects in appropriate technology is telling in that differing perspectives would counter others.

One of the first views of appropriate technology is the "harware" emphasis. This emphasis focuses on devices and techniques as problem solvers, for example, manual and animal powered farm machinery, alternative energy sources, and low cost methods of construction. The Intermediate Technology Group founded by Ernest F. Schumacher. Schumacher, a British economist, believed that ideal societies should be organized into small, decentralized, self suffieient units acting in a collective framework. His major book, Small is Beautiful: Economics asif People Mattered (1973), explains his approach to development and created many adherents to the appropriate technology movement.

Ironically, in an approach that emphasizes the local environment, the emphasis on technology must be classified in the conceptual grouping of Technology Push. The initial appropriate technology approach was its interest in design of prototypes for adaptation in LDC's. Commercial activities in the area of appropriate technology also increased. Commercial enterprises began to produce and promote solar panels for heating and water purfication. The emphasis was to expand the marketing of these devices in LDCs. Many commercial devices were not aimed at specific problems of LDCs but at increasing the market for what are termed Appropriate technology prototypes. When one hears of appropriate technology, "hardware" tends to come to mind first. The hardware emphasis combined with the missionary zeal of many appropriate technology adherents lead to major segments of the appropriate technology movement being classified as "technology push". A criticism leveled against the appropriate technology approach is that it was more appropriate to the values of the donors and developers than those of the recipient country.

Peter Askin (Development Experience Reivews, Appropriate Technology, March 1981)) identifies aspects of appropriate technology that hinder development by offering solutions that are obsolete and inefficient. Numerous articles in GATT publications and from the Group of 77 view portions of appropriate technology as keeping LDCs in a subordinate status. Askin enumerates several arguments against the application of the concept:

* Labor intensive operations are more time consuming and tie up working capital for longer periods of time.

* Capital intensive investments maximize total output in the shortest possible time, and returns are greatest where capital is combined with the most advance technologies

* Labor is not as abundant or as cheap (productivity vs costs) as is commonly supposed in LDCs.

* Many industries are not economically divisible, since they must compete in domestic and international markets. Quality control and precision may be critical and cannot be achieved in small-scale, geographically diverse production units.

* Decentralized, small-scale industries are not conducive to creating an environment of competitive innovation that has been a hallmark of the U.S. system.

Whether Appropriate technology be viewed as a benefit or hinderence it has contributed to a better understanding of the decision making process by both parties in a technology transfer. The next logical development was the development of data bases to organize information about available technologies whether they be "on-the-shelf or appropriate technology prototypes.

Data Base development might be called the software of technology transfer. Information, or knoweldge in the widest sense is a major production factor and can takes its place alongside the traditonal categories of Land ,Labor and Capital. It is difficult to understandhow it canbest be organized and exploited to promote the diffusion of innovations. Many efforts have been made to try to correct the situation by developing more effective means for collecting and diffusing information about technology. Information and documentation centers like the Indian "Small Enterprise Documentation Center", or the Ecuadorian CENDES are only two examples. The author, himself, worked in Mexico at Ivan Illich's Institute CIDOC to develop a technology and know-how data base for Latin America with emphasis on Brazilian the early 1970's.

National and international organizations dealing with information about technologies do to some extent play the role of transfer agents for foreign technology. National organizations tend to be specialized institutes emphasizing information on applied technology. Multinational institutes and their data bases deal not just with the collection and diffusion of information, but also with the development of new technology. It is interesting to note that almost all the multinational organizations like the Intermediate Technology Development Group, are based in the

industrialized countries.

The experience of the various documentation centers in the developing countries shows that information is a very expensive commodity. Three elements are important in information transfer; the collection of information, its storage, and finally its diffusion. Although specific quantitative information does not exist it can be reliably estimated that in developing countries these costs are comparatively much higher than in industrialized countries. Efforts have been undertaken and proposals offered to lower these costs through international computer networks. Though the costs per unit of information can be substantially lowered, the main question in developing and maintaining data bases remain what information and for whom?

All three schools ("off-the-shelf", "appropriate technology", and "data bases")of thought share a common denominator. The common denominator of the technology push approach outlined above provide answers even when no one knows the problem. In a sense these schools of thought are answers in search of questions or needs to address. The technology or information push embodied in AID's early approaches to technology transfer gave rise to Host country/recipient technology development.

HOST COUNTRY/RECIPIENT TECHNOLOGY DEVELOPMENT

The early and mid 70's were a period emphasizing the LDC/recipient technology development. The basic observation that gave rise to this approach was that no matter how important or valuable the technology or information was it was useless if the country could not adapt and assimilate these inputs. The emphasis went from adoption of technology to the capacity for adaptation. Three schools of thought developed in this area including local choice or screening centers, adaptation

through local Science and Technology base and lastly technology assistance. In each of these schools of thought AID's role changed from designing national evaluation centers, to creating country specific research institutes to the provision of technical assistance packages.

Local Choices

As a reaction to the proponents of technology push from the industrialized nations, opinion leaders in LDCs and in several donor organizations advocated screening mechanisms and policy frameworks to preselect technology transfers. Inorder that a country not be taken advantage of and inorder that only technologies in the countries best interest be allowed, national or regional centers were established in the early 1970's. These centers would perform both a regulatory function as well as the matching of the countries requirements with available technologies.

Several Latin and Centeral American countries created screening and matchmaking institutions. Brazil developed industry specific screening mechanisms in areas like the cattle and aircraft industries. The policy framework and regulations were designed in principle to ensure the ultimate transfer of the technolgy through time limitations on ownership of propriety know-how and the requirement for local ownership. James E. Beverly of U.S. AID proposed a similiar screening and matchmaking institution in his paper,"General Description of the Organization of American States Pilot Project for the Transfer of Technology" (1972).

US AID and the US National Science Foundation sponsored several studies on how and by whom are decisions made to transfer technologies. The case studies and conceptual studies investigated the process by which the productive system of a country (public and private enterprises) acquired a technology produced in another country for the purpose of incorporating it into their own system.

These studies recommended that the public sector had a role as the guardian of the country's interests. The public sector, in the form of national centers,was not only to perform task of compiling technology data bases but pursue the active identification and country specific screening and evaluation of technologies.

Improved local choice mechanisms were the first step in adapting technologies suited to country specific conditions. Hand-in-hand with these screening/matchmaking centers was the need for local institutions to customize the foreign technology and provide technical insight into the value of certain technologies. Adaptation through the development of the local S&T base was an important next step in AID's "technology transfer" activities.

Adaptation Through Development of LDC S&T Base

One of the major schools of thought concerning technology transfer and the US AID role is development of LDC Science and Technology Base. The approach of working with the public sector through education, training and research institute creation has been a main aspect of AID's involvement in LDCs. The thinking of this school of thought revolves around the idea that a strong S&T base is developing the capacity for technological advancement. Though it is hard to argue with this school of thought as to the importance of a strong S&T base, one must ask whether it is technology transfer.

Thomas R. De Gregori is a major advocate that a strong S&T base or science transfer must accompany technology transfer for it to take root in the recipient countries. In articles like, "Technology and Operational Principles of Transfer and Development", De Gregori points to the need to integrate the improved problem solving technique into the recipient culture and Link it into the dynamics of the broader international technological system. Research institute development provides an excellent avenue to this goal.

Vernon W. Ruttan makes a similiar point about the S&T base in his article, "Technology Transfer, Institutional Transfer and Induced Technical and Institutional Change in Agricultural Development". Ruttan states that successful agricultural development requires a combination of technical and institutional change. Ruttan points to the components of technology transfer being the material transfer (simple transfer or importation of new materials, machines or management practices), design transfer (characterized by the transfer of information such as blueprints or formulas). Most importantly to the development of aS&T base in country, Ruttan emphasizes capacity transfer which is defined as the transfer of scientific and technical knowledge and capacity with an objective being to institutionalize local capacity for invention and innovation. Under modern conditions technology transfer is increasingly dependent on capacity transfer.

Capacity transfer or S&T institution development may be important preconditions to efficient technology transfer but it is not technology transfer. Ironically, after many of these institutions were developed, the problem of transferring the technology out of the lab in-country was just as difficult as transfering it out of an industrialized nation's labs.

Technical Assistance

The provision of technical assistance through the use of consultants and training programs has been a major avenue of US AID skills transfer. Technical assistance has two components. The firstcomponent is in providing technical assistance from outside the country to train locals and provide spot problem solving consulting assignments. The International Executive Service Corp (IESC) is one technical assistance program partiallysponsored by US AID. The other aspect of technical assistance is in-country extension programs which have been based on the US extension agent programs. Though these technical assistance programs are effective in the long term educational development of the country, difficulty has arisen in focusing the assistance on completing specific technology transfers due to the inflexible and long lead times for US AID contracting proceedures.

MARKET PULL

Numerous criticisms have been addressed to the technology push and recipient development schools of thought. The appropriate technology emphasis on establishing decentralized, independent communities and the dedication to local S&T development resulted incertain cases of countries isolated from the competitive domestic and international marketplace. Much like the earlier import substitution policies, the results of technology push and the Local S&T development approaches resulted in a uncompetitive industry in both the public and private sectors.

The movement from sole reliance on the technology push mechanism for inducing technological and economic change corresponds to results from studies performed by Arthur D. Little and SRI International for the NSF on "Barriers to Innovation and Technology Transfer" on both domestic and international firms. The interest in the private sector as the engine of economic growth caused a reassessment of the donor country public sector working with the host country public sector.

According tothese studies the primary barrier to technological innovation relates to marketing. With the increasing requirement of LDCs to obtain foreign exchange, private sector exports and marketing was of prime importance to the donor organizations like AID and the countryitself. More specifically, uncertainity of market information, market fragmentation limiting market size, and difficulties in identifying and developing new market areas are considered main impediments to the effective implimentation of transferred technology. Market information was directly related to the business persons ability to evaluate risk andthus the ability to invest or search out newtechnologies.

Poor management or overmanagement is the next most common reason for failure in making a technology accepted. Marketing and management problems account for roughly half of the innovations which fail. Other reasons for failure in accepting innovations arise from lack of capital, particularly venture capital, and governmental policies and practives relating to

exports and regulatory matters. Interestingly, technological factors such as the availability and reliability of technical information were not the top impediments. The major difficulties in the transfer of a technology are nontechnological and are related to marketing, management, capital and government regulations and the policy environment.

Policy Initiatives (Market Pricing)

As experience from the field has indicated,certain technology transfer projects were not successful due to the governmental policies. It has been found in the articles reviewed and in the interviews conducted, that various governmental policies particularly in the pricing of products inhibits the adoption of a technology. In Henry L Miles' article,"Obstacles to Transferring Technology to the African Smallholder"(1982), he states that the actions and adoption rates for new technology are based on economic incentives. He states further that governments in the SubSahara region deter adoption of new technologies and heightened agricultural productivity by:

* Setting prices for most agricultural commodities well below the market price.

* Allowing inefficient governmental marketing procedures characterized by late deliveries of agricultural inputs and late payment to farmers.

Assistance in developing a consistent and beneficial policy context in targeted countries is presently a favored approach to foster the transfer of technologies. Numerous countries like Peru, Haiti and Jamaica are currently receiving assistance from US AID in policy rationalization. Policy initiatives does assist in the transfer of technology but the clearing away of inhibiting factors does not transfer the technology , it only makes it easier. Proper policy changes can allow the marketplace to work in a manner

that encourages risk taking and investment in new technology and know-how.

Market Data Bases

The movement in priorities from attention on S&T institutional development and the public sector institutional development to the marketplace was caused by a redefinition of who AID was trying to assist. These public sector institution's know-how and knowledge was to "trickle down" to the private sector. Unfortunately the problem of technology transfer was not solved by the creation of new intermediaries. The research programs and institutions were beneficial but the rate of transfer was unsatisfactory. Therefore there has been interest in the 1980's in providing information directly to the private sector through market data bases. Programs like the Atlanta Marketing Center and the Chicago Chamber of Commerce have provided market related information about the US directly to private sector companies inorder that they are better equipped to enter the US marketplace.

What has become a critical element in Market Data Bases is the credibility and timeliness of the information. The traditional consultants and academic personnel who undertake these studies for AID have been criticized for their inability to distinguish between information and a business insight. The problem of timeliness is also an important determinant in whether the information is transferred to the decision makers. The procedure for contracting does not usually allow for rapid turn around that would match the questions raised by businesspeople.

Another irony in the field of technology transfer is that when information is freely available to anyone, no one will take the risk in acting on the information. The psychology of the situation means that if a person were to capitalize on some information then another person could also develop that idea and provide immediate competition. For example, several marketing reports identified a market niche in the US for a product that could be grown in Central America. The result was

overproduction of the product with the resulting low prices being paid for those lucky to find a buyer. The difficulty in deciding who should get the information when a governmental body is involved presents a major difficulty. This issue goes to the heart of the problem of US AID's involvement in the private sector. The traditional means of "technology transfer" with government to government transfers did not create a problem with who would benefit from donor involvement. Preserving objectivity as the US AID's programs are directed to the private sector has become a major issue.

As with other passive sytems in technology transfer, Data Bases do have their limits. More active means of providing directed information and marketing assistance was inevitable.

Market Intermediation- Brokers, Traders and Marketers

The latest US AID programs and field trials involve private sector brokers, traders and marketers from the donor country working with the host country's private sector. The marketing and technology transfer services provided have been termed "intermediation". Instead of the provision of information, the various intermediaries AID is working with are brokering deals, trading products and marketing goods and services. Through the use of networks the various intermediaries are able to link together sources of technology and products with the demand side for the know-how and goods. The various intermediaries provide an essential element in the technology transfer process - communication. With the previous work already accomplished by various donor agencies the intermediaries could provide the needed integration function to finalize the transfer of technologies.

It is increasingly clear in the recent development literature that living standards in developing countries can be raised on a permanent and continuing basis only if these countries enter into full participation in the world marketplace, where they can both find and offer suitable technologies. The choice and placement of

a technology should be supplemented by support or software servicessuch as training, management consulting, marketing assistance, information processing, and management services. Adequate support services are essential for the most effective use of products and smooth the intorduction of new technologies, particularly in countries having little experience in these areas. The new technologies - products, processes, and services- can be introduced at a faster rate under this approach through intermediaries who canorganize the required support services and provide the contacts and productive communication between the parties involved. The process of technology transfer to, from, and among developing countries might be speeded up by intermediaries who could bring together not only individual entrepreneurs and commercial organizations but also traders and brokers, government trade officials, representatives of development organizations and potential providers of development capital. The development and use of intermediary organizations (12 Intermediary Organizations' Case Studies, Arthur Young and Company for US AID's S&T Bureau,1984) are intended to create the required communication and integration as profit seeking, self sustaining organizations to facilitate the Third World's direct and competitive access to world markets.

A major role for intermediaries is fostering better communication. A novel approach recently undertaken is to employ the skills of marketers to create the demand for innovative products in the developing world. The approach circumvents the "chicken and egg" problem of which comes first the market or the technology/product. The software technology of advertising has been successfully attempted to aid in the adoption of the use of mother's milk and Oral Rehydration Therapy. Articles such as "Integrating Communication Approaches for Development" by Dr.Anthony J. Meyer and Dr. William Smith and Peru: The Marriage of a Ministry and an Ad Firm" by Dr. Anthony J. Meyer and Art Danart outline the

recent successes in using certain mass media and social marketing approaches to achieve educational breakthroughs in familiarizing the populace with specific health technologies.

Summary

In outlining the development of US AID's involvement in the field of technology transfer it is interesting to note that it has been a dynamic search for workable solutions. Each approach had its own limitations which lead to the next emphasis and program focus. No one approach was right or wrong, but is part of AID's search for workable methods.

The three major approaches and various schools of thought identified in this section provides an almost complete spectrum of various methods to be utilized. The goal of transferring technology has not changed during this twenty five year period. The means of technology transfer and in particular the target audience (in its shift from the public to the private sector) has changed over this period.

The major criticism that can be lodged against AID's approach over this period is that the problem of technology transfer has been addressed piecemeal and has been too fragmented to incorporate the complexity of the economic,governmental, cultural and technological worlds it is trying to change. Elements in the technology transfer process have been identified and acted on but the approach does not systematically address the interactions of the source and receiving systems. A systems representation of the technology transfer process is illustrated in Exhibit 3. As we reflect over thedevelopment of US AID's concept of technology transfer, it is important to note that the first approach - Technology Push - fits neatly into the left side of the exhibit with the technology source and generating system. The second approach of host country development and development of S&T institutions is encompassed in the right side of the diagram. The third approach of Market Pull provides integration through intermediaries and in focusing on

A SYSTEMS REPRESENTATION OF TECHNOLOGY TRANSFER PROCESS

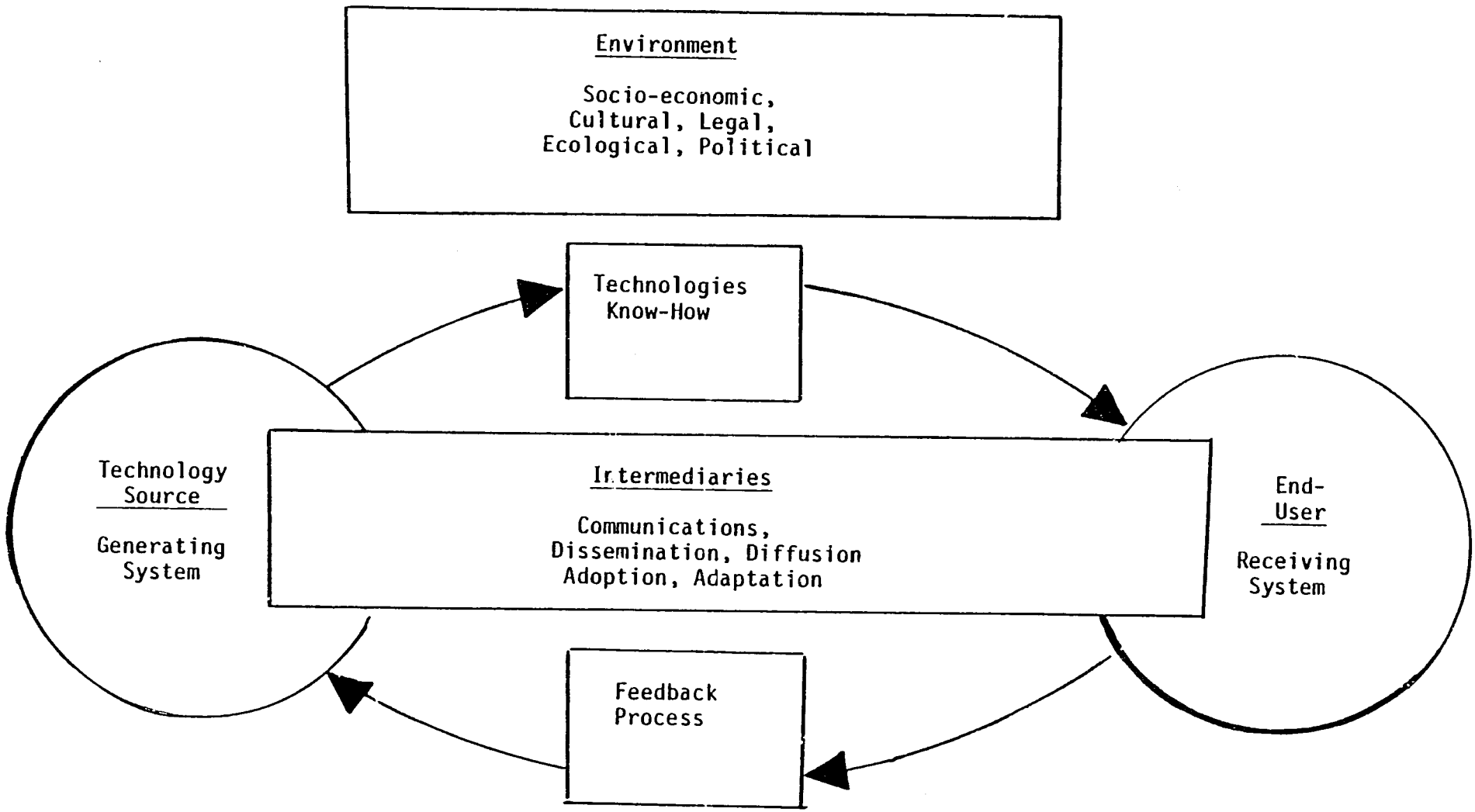

EXHIBIT 3

the environmental/policy considerations that link the source and receiving systems. These aspects are represented in the center of the diagram. In a sense all the elements of the technology transfer process are represented in the approaches tried by US AID. The issue now is to take this growing systems understanding of the technology transfer process which attempts to understand the interdependent relationships between new and existing institutions and technologies and make it work. The problem that is currently troubling AID policy makers is not whether AID has transferred technologies but the rate at which technology can be transferred more efficiently. The latest approaches undertaken by AID do not focus merely on therecipient or source/supplier but on their interaction and communication. Market dynamics and marketing mechanisms do provide one means for integrating the two seperate worlds always existing in the technology transfer process. The challenge facing Policy development is evaluating programs to identify the larger universe of approaches that work and mechanisms that have been successful. The transfer of workable mechanism should be a prioity issue at AID. We have far to go in understanding the nature of the technology transfer process.

ANNOTATED BIBLIOGRAPHY

Prominent U.S. A.I.D. documents on technology generation, transfer and dissemination.

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PROMINENT U.S. A.I.D. DOCUMENTS ON TECHNOLOGY GENERATION, TRANSFER AND DISSEMINATION

I. General Documents

A. "Internal Memo - U.S. A.I.D., A.I.D.'s Role - Technology Transfer - ARD"

This paper includes a short discussion of the technological gap between developed and developing nations, a broad definition of technology transfer and an assessment of the success rate for a sample of selected projects (139 projects comprising over $920 million, of which 69 projects have been evaluated). The success or failure of a "technology transfer" project was determined by 1) breaking down the A.I.D. projects with substantial technology transfer components into three categories*, 2) determining the seven major sectors in which these projects are concentrated and 3) analyzing various problems of implementation.

Category I - Projects which have technology transfer as the main objective or purpose.

Category II - Projects which have technology transfer on an equal level with another principal objective or reason for doing the project.

Category III - Projects which have technology transfer only as a major component needed to help the project achieve its purpose.

Some of the major findings are:

- The Africa Bureau preferred using Category III projects while the Latin America Bureau preferred using Category I type projects.

- When an agency develops projects with high technology components it tends to <u>favor</u> projects which have technology transfer as the <u>main</u> project objective.

- Category I projects had the highest positive assessment (69%) while Category III had the lowest (44%). An implication than projects which have technology transfer as the <u>main</u> <u>objective</u> have a higher propensity for success than projects with technology transfer only as a major component.

- Projects with technology transfer as the main objective tend to be less complicated and easier to manage, and need fewer people/institutions to carry out. In contrast, Food and Agricultural Projects are generally long-term, complicated projects requiring more manpower and institutional involvement.

- Projects in the Food and Agricultural Sector encountered over half the fifteen major start-up problems

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while Planning/Administration, Technology Transfer and Participant Training and Energy experienced less than a quarter (22%) of these problems.

- There has been a substantial effort to increase technology transfer projects over the past four years, but more extensive analysis is needed to determine definitive patterns in projects involving technology transfer.

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I. GENERAL

B. "Characteristics of Technology and Technology Transfer"

De Gregori

De Gregori makes a brief statement on technology transfer. According to him, the "central unifying characteristic of technology" is its basic function as a problem solving process. This problem solving process involves tools and the skills and ideas necessary to employ the tools. Use of these tools by humans is dynamic, combinational and accelerating in the continuum of time.

More specifically, he states that technology transfer is basically the transference of new improved ways of carrying out a task and its adoption and integration into an ongoing economic/societal system. He qualifies the initial stage of technology transfer by stating that it can be 1) new ways to use existing technology, 2) a training program, or 3) a combination of both, including products of modern science and technology.

Most importantly, the author emphasizes the need to integrate the "improved problem solving technique" into the recipient culture and link it to the dynamics of the broader international technological system.

B. De Gregori, Thomas R. "Technology and Operational Principles of Transfer and Development" (Chapter III of new book _____)

This chapter is comprised of 30 statements which attempt to describe the concept of technology including its basic elements and some of the problems/benefits that arise from transferring it to other cultures. Some of the major points include:

- Technology (human tool using) is an ideational process used to transform the material and non-material world. This "idea transfer" implies that "science transfer must accompany technology transfer..." for it to take root in recipient countries.

- Technology is a behavioral process that is transmitted through culture. It becomes organizational and institutional and is a cumulative/combinational and accelerating process. It is problem-solving by nature and requires interaction.

- Technology provides ideas and instrumentation that facilitates scientific advancement (principles established by scientific inquiry).

- Technologies, separated from major areas of technological change by geography, culture or political isolation, tend to slow innovation.

- Technological interdependence or complementarity in complex technologies means that some improvements in a technology require advances in several areas.

C. Beverly, James E. "General Description of the Organization of American States' Pilot Project for Transfer of Technology," Proceedings of the International Seminar on Dissemination of Technology.
Presented by Carlos A. Martinez Vidal in Seoul, Korea, November 20-22, 1972.

In the general description of the OAS' Pilot Project for Transfer of Technology, a system for assessing the "transfer of technology" is described. First, the transfer of technology is defined as a process by which

the productive system of a country (public and private enterprises) acquire a technology produced in another country for the purpose of incorporating it into their own system. Secondly, the phrase "Technology Requirement" (TR) is the name given to the concise and clear definition of a user's technical or technical-economic problem. The solution to a TR can be: a system or process, a subsystem, mechanisms, component, product or material; or a method, technique or conceptual approach.

The Pilot Project experiment was limited to three sectors of the productive system. The system of analysis offers a basic format which can be applied in similar situations. In particular, the project recognized an "explicit demand" for specific technical solutions and the need to establish information links with other countries to utilize existing world sources of technology.

"Market and Technology Access Project (MTAP)"

--Study Group

The "Market and Technology Access Project (MTAP)" is an innovative attempt by the Agency for International Development (A.I.D.) to both transfer technology to the developing countries and to provide them market access to the developed countries. Instead of using the standard approach of providing aid from the government or private sector to the government or private sector MTAP will develop collaborative ventures from the private sector to the private sector.

The project will fund three intermediary organizations. These organizations with financial assistance from A.I.D. will design, implement, and evaluate methods of collaborative ventures. After an initial period of three years the intermediary organizations would be able to act independently by being commercially viable.

The intermediaries will focus on market and supply relationships, subcontracting, training and management contracts, liscensing agreements, and joint ventures. To achieve these collaborative ventures a four step process will be used which includes:

-Identification of opportunities for collaborative ventures

-Developing searching/screening mechanisms

-Providing matchmaking services

-Providing planning and facilitation services

The project is designed to circumvent prior approaches through governments and large multinational corporations of transferring technology and providing

market access by using small to medium sized enterprises (SME's). SME's have distinct advantages over governments and multinational corporations including: faster decision making, more compatability with developing countries, and often tend to be more innovative.

Because MTAP is a new concept A.I.D. has two additional purposes: to develop and test methods for assisting SME's to establish collaborative ventures and to establish cost and performance guidelines.

Over a five year period MTAP is expected to produce the following:

-An overview report on approaches and programs

-Four evaluation reports analyzing and documenting the field trials

-A final comprehensive report that includes a comparative analysis of the approaches and that sets out cost and performance standards

-Four research and evaluation workshops designed to both generate and disseminate information relating to collaborative ventures.

II. AGRICULTURE

A. Miles, Henry L. (Bureau Evalution Officer, Africa Bureau) "Obstacles to Transferring Technology to the African Smallholder", presented June 1982.

This paper addresses the reasons for a stagnating economy in Sub-Sahara Africa. The Sub-Saharan region relies most heavily on agriculture for economic growth, but various governmental policies inhibit adoption of technologies which would increase agricultural productivity. In the 1970's, annual agricultural growth fell to about 1.3 percent while the population rose about 2.7 percent.

It is apparent that smallholders' decisions to increase agricultural productivity are based on economic incentives. However, governments in the Sub-Sahara region deter adoption of new technologies and heightened agricultural productivity by:

- setting prices for most agricultural commodities well below the market price;

- allowing inefficient marketing procedures characterized by late deliveries, late pick up of harvested crops, and late payment to farmers;

- fostering scarcity of goods, economic insecurity and resultant corruption of public officials;

Finally, the study points out that planners/researchers need to gain an understanding of the entire subsistence farming system in order to promote technologies successfully. A workable technology transfer program must address the needs and goals of the smallholders rather than purely national goals.

B. Morris, Jon R. "What Do We Know About African Agricultural Development? The Role of Extension Performance Reanalyzed". Executive Summary prepared for the Bureau of Science and Technology, U.S. A.I.D.

This paper gives extremely detailed reasons for "why technology transfers have not worked as the solution to Africa's needs for rapid agricultural development." There is widespread consensus that even though the symptoms are economic, the causes are rooted in the managerial, administrative, cultural, and ecological systems.

The author points out specific aspects of African culture, i.e., tribalism, and history, i.e., recent independence from colonial rule, that have made agricultural performance particularly weak. Furthermore, he notes that all field activities and agricultural extension agencies are subject to severe administrative malfunctioning.

The paper focuses on the problems of utilizing present technologies and offers a few suggestions for improvement. Some of the particular measures recommended were:

- employing a process-oriented analysis instead of a policy-oriented analysis;

- using the "farming system research" (FSR) results effectively by developing ability to handle technical information;

- creating a clearer idea of how to manage field extension activities in ways that meet farmers' needs; and

- changing the larger bureaucratic environment to encourage effective managerial behavior.

C. Swanson, Dr. Burton E. (Associate Director, INTERPAKS) and Claar, Dr. John B. (Director, INTERPAKS), "Technology Development, Transfer and Feedback Systems in Agriculture: An Operational Analysis.

This paper addresses the problem of agricultural research and extension institution's inability to make available to farmers improved technology that is suited to their needs. According to this assessment, the process of technology development and transfer is in dire need of reassessment and improvement. Some of the major reasons for this reassessment are:

- targeting projects <u>without</u> attention to the <u>linkages</u> and <u>interdependencies</u> of a functioning system;

- failure to use resources of the private sector or indigenous knowledge and interest;

- lack of supportive government policies; and

- insufficient backstopping.

This analysis offers a proposal for addressing these problems and arriving at framework and a set of sensitizing concepts for examining and evaluating systems to be used until a better fit has been established.

D. Pray, Carl E. and Ruttan, Vernon W. "Private Sector Innovation and Technology Transfer in Asian Agriculture: A Research Proposal," University of Minnesota, September 30, 1983.

This paper addresses two major issues in transferring technology to Asia: 1) what role the private sector should play in developing and transferring new agricultural technology in Asia and 2) how Asian governments and A.I.D. can influence the size and direction of private sector innovation and technology transfer.

The paper is in a proposal format, and consequently, raises questions without giving definitive data to support them. However, some of the questions are important in themselves. Some of the questions revolve around:

- discerning the impact of the generation and transfer of agricultural technology by the private sector;

- reviewing government policies affecting innovation;

- gaining a better understanding of the decision making process employed by organizations which transfer technology;

- determining how private research would affect income distribution; and

- understanding A.I.D.'s role vis-a-vis the small farmer, the private sector and technology transfer in agricultural development in general.

The paper offers a one format for answering the above-mentioned questions.

"Technology Transfer, Institutional Transfer, and Induced Technical and Institutional Change in Agricultural Development"

Vernon W. Ruttan

Ruttan states that a successful agricultural development strategy requires a combination of technical and institutional change.

He briefly discusses the history of technology transfer and then the need to distinguish its three phases including: Material transfer - involving the simple transfer or importation of new materials, such as seeds, plants, machines or management practices associated with these materials. Design transfer - characterized by the transfer of information in the form of blueprints, formulas, journals and books and related software, and Capacity transfer - the transfer of scientific and technical knowledge and capacity with an objective being to institutionalize local capacity for invention and innovation. Under modern conditions technology transfer is increasingly dependent on capacity transfer.

Ruttan illustrates the three phases through the example of the diffusion and development of sugar cane. He discusses how the cane was physically transferred, how the growing design was rapidly diffused, and how scientific methods of disease elimination were transferred.

In viewing modern technology transfer the author believes the literature on institutional transfer and innovation is unsatisfactory. He then discusses the institution building perspective and how it involves a "normative

orientation toward social change". An "institution" is viewed as a package of behaviors and relationships that describe a particular organization and its interactions with its environment. From the institution building perspective it is the normative impact of the organization on its setting, such as impact of new knowledge resulting from research on the incomes of producers/manufacturers. This is important because the effectiveness of technical assistance has substantially impacted institution building literature.

Ruttan discusses the "closed system" quality and non-closed system of technology to assess their impact. The relatively "closed system" quality of many technologies means that behaviors they require are quite particular to their operations and not the socio-cultural system at large. Effective institutionalization may be difficult to achieve where there is not closed system technology, as in community development efforts.

He examines models of bureaucratic behavior to also discuss their impact on technology transfer. He illustrates this impact with the Second Enclosure Movement in England. His conclusion from this discussion is that the capacity to use the tools of economics on the process of institutional transfer and innovation or on the interaction between technical and institutional change is "rudimentary".

Ruttan argues that the policies a country chooses with respect to allocation of technical resources and institutional innovation must be consistent with physical and naural resources if the policies are to be "efficient".

Agriculture

"Agricultural Technology Management"

--Ralph W. Cummings Jr.

Cummings first proposes the problem that while agricultural production has increased substanially over the last twenty-five years this increase has not applied to all countries. The question is why are the farmers in the least productive agricultural countries not applying all of the recommendations made to them.

The new technologies will play a role towards improving yields but only if incorporated into a larger framework that also includes institutions and the individual procedures. An effective national agricultural technology management system must be holistic and must encompass each of the following key objectives:

Setting Objectives- They should be challenging but reasonable for they determine the tone and efforts.

Defining the Technology Agenda-This defines what the technology management system intends to do in order to achieve its goals.

Enforcing the Technology-The system must do what it says it will do.

Generating Technology-This involves doing research to develop the possible solutions.

Asserting Technology-The technology is evaluated as to whether it is feasible, profitable, sociallly acceptable, and environmentally sound.

Diffusing Technology-This involves the extension aspect and the several roles involved in getting the technology out to where it is to be used.

Developing Manpower-To have a successful program requires the need to produce in-country personnel who will have the necessary skills and knowledge.

Promoting Continuous Stable Support-Long term support by the government is necessary to have a successful program.

Agricultural

"Technology Transfer and Resource Transfer in a Country Setting"

Erikson

Erikson's paper explores the relationship between technology transfers and resource transfers, and the implications of an increased emphasis on technology transfer in the country setting of Bangladesh where A.I.D. provides Development Assistance.

He defines technology transfer as know-how or expert advice, and vehicles and equipment required for use by technical experts. Resource transfers is all other forms of assistance ranging from few specified productive inputs such as fertilizers and medical supplies to financing of projects.

Bangladesh is unique in that it contains a substantial resource transfer element in the form of projects providing commodities and little technology. Erikson notes that while a major motivation is humanitarian, the intent of donors is to ensure that aid is utilized in ways which are not only short-run needs but also builds capacity for economic development on an independent, self-sustaining basis.

The first question that is asked in the paper is: Which projects contain separable resource transfer elements that might be reduced and what would be the consequences of such reductions?

Erikson estimated that if aid for fertilizer and contraceptive

commodities where reduced, substantial amounts of funding would become available for projects in bangladesh with larger technology transfer elements.

However, Erikson states that if dramatic cut backs are made in fertilizer and contraceptive commodities: 1) it could be seen as reneging on our side of the "package" developed during the policy dialogue 2) other donors would have to be found to ensure that food production performance is sustained 3) and if A.I.D. provision of contraceptive were to be terminated, the project objective of creating a legally independent nationwide organization for marketing contraceptives through the private sector would not be accomplished. Erikson's conclusion from this examination is that if technology transfer is to be increased at the expense of resource transfer, than any future year reduction should be gradual rather than abrupt.

The second question asked in the paper is: What are the best opportunities for increased technology transfer assistance in Bangladesh and what would be the consequences of such increases?

Erikson points to detailed analysis which suggest that agricultural research, education and extension system could probably be strengthened beyond the scope envisioned. It should be noted that 1) the expansion of physical facilities. 2) high payoff exists in Bangladesh for increased technical assistance and training intended to make existing irrigation systems

more efficient 3) a host country's demand for training in particular under flexible projects typically outruns the supply of funds.

Erikson then concludes with several general considerations: 1) the technical expertise must be relevant and highly competent 2) a greater empasis on technology transfer for the same size total program is likely to be more A.I.D. staff-intensive 3) long run involvement, at least ten years, is required if impact of development is to be lasting 4) there are limits to a country's absorptive capacity for sharply increased technology transfers, especially in the short run.And finally Erikson concluded that 5) while it is not possible without further investigation to indicate in which countries increased funding for technology transfer might be most productively absorbed, it would appear that low income countries with minimal or totally lacking agricultural research, education and related development institutions would be logical candidates.

III. HEALTH

A. Bloom, Abby L. "Prospects for Primary Health Care in Africa: Another Look at the Sine Saloum Rural Health Project in Senegal" (A.I.D. Evaluation Special Study No. 20)

This study gives concrete examples of how "altering technology transfer," particularly in the areas of general management and financial management, can turn around a failing program. After a critical evalutation of Sine Saloum's Rural Health Project, certain modifications were introduced with the Government of Senegal's willing support. Some of the major changes include:

- development of a viable fee-for-service system;
- introduction of a new management structure, including better delineation of responsibilities and coordination of activities;
- intensified training of villagers to increase their understanding of the health program and their responsibilities for financing and managing activities;

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Some of the questions that remain to be answered concern:

- financing of supervision costs;
- providing preventive as well as curative health measures;
- ensuring available and accessible health care during peak disease months; and
- increasing community involvement and utilization of the PHC.

B. Meyer, Dr. Anthony J. (Presenter, representing Development Communications Division, Office of Education, Bureau for Science and Technology, A.I.D.) and Smith, Dr. William (co-author, Academy for Educational Development). "Integrating Communication Approaches for Development".

This paper discusses the use of mass media in health education, in particular education on a new oral formula used in the treatment of infant diarrhea. The assessment determined that traditional advertising models "were useful, but had limitations." However, adoption of specific advertising techniques in Honduras and the Gambia had a dramatic impact. The adaptation included:

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- closer coordination of rural mass media — radio and simple print materials — with training and face-to-face client contact, over an extended period of time;

- utilization of unusually detailed village-level investigation to supply data for the development of messages and ad material; and

- employing principles of instructional design drawn from behavioral psychology to guide the investigation and message development.

The project in each country achieved 95% coverage with over 50% efficacy.

The paper gives many concrete examples of how this adaptation of advertising techniques was carried out.

C. Meyer, Anthony J. Dr. and Danart, Art (M.P.H.). "Peru: The Marriage of a Ministry and an Ad Firm". Presented before the National Council for International Health, International Health Conference, Washington, D.C., June 12, 1984.

This paper addresses the problem of achieving massive outreach to semi-literate, traditional populations in order to educate them on primary health care programs. As noted, certain mass media and social marketing approaches are achieving educational breakthroughs in familiarizing the populace with specific health technologies.

Instead of using the typical advertising models which suffer limitations in outreach, new approaches are being developed. The new approaches include multi-channel, marketing strategies which are more deliberate in the application of behavioral insights and which rely more heavily (than former programs) on data from the end user. This specific approach incorporated three important elements: 1) use of focus groups, 2) attempt to shape new skills based on a mother's previous knowledge and experience, and 3) utilization of a trainer component with significant interpersonal contact.

The paper includes a checklist for social marketing and specific ways that mass media/social marketing achieved positive results.

D. Beverly, James E. "Summary of A.I.D. Office of Health Technology Transfer Workshop, April 19-20, 1983." Prepared for the Office of Health Bureau for Science and Technology, U.S. Agency for International Development - Under Order of Technical Direction No. 50.

This paper covers the outcome of a two-day workshop on Technology Transfer in the water supply and sanitation sector. The workshop had two main objectives: 1) to develop a better appreciation of the technology transfer process as an integral part of A.I.D.'s programs and 2) to review the pros and cons of various low-cost, easily maintained water and sanitation devices that have potential to be manufactured in developing countries. Some of the broad-reaching conclusions are:

- The success of many foreign-aid programs can be traced to their intimate knowledge of local conditions and less on the hardware developed.

- Economic conditions in LDCs necessitate finding some mechanism to convert local currency to dollars in order to purchase "imported technology".

- Although research is an important component of technology transfer, early development of an administrative framework is necessary to ensure effective performance and stimulation of innovation in developing countries.

- Users of the "product" must be integrated into the process to ensure their long-term participation in the operation and maintenance of systems.

The paper also addresses the question of commercializing a product or service in a developing country so the private sector can eventually take over its manufacturing and marketing. Useful tables included.

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