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Mechanisms for Strengthening Applied Research Institutes In Developing Countries

Report of a Conference Supported by
USAID Contract No. AID/DSAN-C-0214

Edited by

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Conference Director

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APPLIED RESEARCH INSTITUTES
IN DEVELOPING COUNTRIES

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FOREWORD

An experiment with mechanisms and programs for strengthening applied research institutes in developing countries and with approaches to influencing their programs in directions which have more relevance for national development in these countries was initiated by DRI in 1973 under the sponsorship of the U.S. Agency for International Development (AID). After six and a half years, the experiment was near its termination and both AID and DRI believed that significant lessons had been learned and substantial issues identified during the course of the experiment and that these warranted examination and discussion beyond what would occur in a final report. It was decided to hold a conference at which a few selected experts in development science and technology would examine, analyze, and discuss the results of the experiment.

The conference was held from 27 through 29 November 1979. Representing developing country applied research institutes were: Dr. Smith Kampempool, Governor of the Thailand Institute of Scientific and Technological Research; Dr. Jaime Ayala R., Director of the Instituto de Investigaciones Tecnológicas of Colombia; and Dr. Abdul Ghani, Chairman of the Pakistan Council of Scientific and Industrial Research. Each of these gentlemen had been directly involved in the experiment, as their organizations served as test cases for institutional linkages as a mechanism for achieving the project's goals.

From the United Nations system were: Ms. Sjamsiah Achmad of the UN Office of Science and Technology, who has served for many years as a member of the senior management of the Indonesian Institute of Sciences (LIPI); and Mr. Raymond Kitchell of UNIDO, who has recently managed the evaluation of past UNDP/UNIDO support for industrial service and research institutes.

Ms. Barbara Lucas of the U.S. National Science Foundation represented those concerned with "research on research." Ms. Lucas is involved with designing projects to measure the effectiveness of various policies and mechanisms for building scientific and technological infrastructure.

Representing AID were Mr. Roger Moeller and Ms. Ruth Flynn of the Office of Science and Technology. Mr. Moeller had been the AID project monitor for much of the experiment. Ms. Flynn had worked with Mr. Moeller in overseeing the project.

Mr. Charles Sewell, President of the Deposit Guaranty Trust Company, came from the private sector. Mr. Sewell had followed the experiment virtually from its beginning as a consultant to AID for the purpose of assisting AID in project evaluation. Many improvements in the experiment resulted from Mr. Sewell's suggestions.

Mr. James P. Blackledge participated in the conference as a DRI consultant. Mr. Blackledge, while Director of the Denver Research Institute's Office of International Programs, developed the original project design. He is indeed the "father" of the experiment.

While not present at the conference, several other people of importance to the experiment should be mentioned. Mr. Henry A. Arnold was the Director of AID's Office of Science and Technology at the time of the initiation of the experiment and was the original project monitor. He influenced both the project's design and subsequent program improvements. His intellectual contributions were of major importance. In addition, Mr. Clinton A. Stone and Mr. William O. Roseborough both served as AID project monitors during portions of the experiment and both contributed substantial intellectual input to the program.

Former DRI staff members who made significant contributions to this experiment include: Dr. Theodore W. Schlie, Prof. Arie Beenhakker, Mr. Milan Radovic, Mr. Joseph C. Profita, and Dr. Richard S. Roberts, Jr.

Office of International Program staff members who participated in the experiment and the conference are: Ms. Laurie N. Adler, Ms. Judith E. Blum, Ms. Melinda Cain, Mr. Donald D. Evans, Mr. James W.D. Frasc e, Ms. Walairat Suchat, Ms. Suellen White and myself. In addition, many staff members from other DRI divisions made contributions during the experiment.

Dr. Shirley A. Johnson, Jr., the Director of DRI, supported and participated in the program from its inception. He also opened the conference by welcoming the participants.

In addition, contributions to this experiment were made by persons in many other U.S., Canadian, and European institutions as well as by persons from several international and approximately one hundred developing country organizations.

Our hearty thanks go to all of these experts.

Ronald P. Black
Conference Director
April 1980

LIST OF ACRONYMS

AID	Agency for International Development
ANDI	National Association of Industrial Development
ARI	Applied Research Institute
ASEAN	Association of South East Asian Nations
ASRCT	Applied Scientific Research Corporation of Thailand (now TISTR)
ATDO	Appropriate Technology Development Organization
CARIRI	Caribbean Industrial Research Institute (Trinidad)
CIDA	Canadian International Development Association
CCTV	Coordinating Committee for Voluntary Work in Colombia
CISIR	Ceylon Institute of Scientific and Industrial Research (Sri Lanka)
COLCIENCIAS	Fondo Colombiano de Investigaciones Cientificas y Proyectos Especiales
CSIR	Council of Scientific and Industrial Research (Ghana)
CSU	Colorado State University
DOE	Department of Energy
DRI	Denver Research Institute
DTEC	The Thai Department of Technical and Economic Cooperation
DTF	Development Training Forum
EPA	Environmental Protection Agency
ESCAP	Economic and Social Commission for Asia and the Pacific
ESPOL	Litoral Polytechnique School (Ecuador)
FIIR	Federal Institute of Industrial Research (Nigeria)
FPC	Fish Protein Concentrate
GRA	Graduate Research Assistant
HFS	High Fructose Syrup

IDB	Inter-American Development Bank
ICAITI	Instituto Centroamericano de Investigación y Tecnología Industrial
IFT	Institute for Food Technologists
IIMM	Institute of Mining and Metallurgy (Bolivia)
IIT	Instituto de Investigaciones Tecnológicas (Colombia)
INDOTEC	Dominican Institute of Technology (Santo Domingo)
IPT	Instituto de Pesquisas Tecnológicas (Brazil)
IRSI	Industrial Research and Service Institute
ISTC	Institute of Scientific and Technological Cooperation
ITINTEC	Instituto de Investigación Tecnológica Industrial y de Normas Técnicas
KIS	Know-how Information Service
KIST	Korea Institute of Science and Technology
LATU	Technological Laboratory of Uruguay
LCT	Laboratoire Central de Tunisia
NCWT	National Council of Women of Thailand
NGO	Non-Governmental Organizations
NIDA	National Institute of Development Administration (Thailand)
NRC	National Research Center (Egypt)
NTIS	National Technical Information Service
NWA	Network Analysis
OAS	Organization of American States
OIP	Office of International Programs, Denver Research Institute
OR	Operations Research
OST	Office of Science and Technology, AID

PAN	Plan for Food and Nutrition (Colombia)
PCSIR	Pakistan Council of Scientific and Industrial Research
PVO	Private Voluntary Organization
R&D	Research and Development
RSS	Royal Scientific Society (Jordan)
S&T	Science and Technology
SENA	Colombian Productivity Center
SDI	Selective Dissemination of Information
STI	Scientific and Technical Information
TCDC	Technical Cooperation among Developing Countries
TDC	Technology Development Corporation
TISTR	Thailand Institute of Scientific and Technological Research (formerly ASRCT)
TNDC	Thai National Documentation Center
TNO	Technology Research Organization, The Netherlands
UNCSTD	United Nations Conference on Scientific and Technological Development
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
USDA	United States Department of Agriculture
VITA	Volunteers in Technical Assistance
WID	Women in Development
WAITRO	World Association of Industrial and Technological Research Organizations

INTRODUCTION TO CONFERENCE

Ronald P. Black
27 November 1979

This conference is the culmination of a six-and-one-half-year program aimed at examining and experimenting with various approaches to strengthening scientific and technological organizations in developing countries. It is an experiment that has been sponsored by U.S. AID and conducted by DRI, along with a number of other institutes in developing and industrialized economies.

AID has invested about \$2.5 million in the experiment, and this conference follows at a rather propitious time, coming, as it does, when some new ventures into development science and technology are getting ready to be undertaken in the world. A number of ongoing programs are looking at new directions, and some of the established programs are experimenting with techniques used in the DRI-AID program.

Following World War II, it was believed that science and technology could solve most of the world's problems. In developing countries, these were often problems of unemployment, underemployment, malnutrition, poor housing, poor educational facilities, the lack of roads in up-country sections of these nations, and every other demonstrable evidence of poverty.

To take advantage of this panacea, many nations began setting up institutions to carry out research and development in agriculture and industrialization. This was often done with the assistance of international organizations, and, on other occasions, industrialized nations. At the time, however, that AID was getting ready to initiate this experiment and was contemplating what should take place, it had become apparent that these newly established institutes had not solved the problems of development. In fact, it was questioned whether they were even making significant contributions in this direction.

Also at about this time, a number of studies and analyses were conducted on the institutions, their situations, and their environments. Perhaps the most exhaustive was James Blackledge's comparative analysis of about eighty institutions in approximately forty countries. The National Academy of Sciences and other organizations carried out similar analyses of such institutions. Virtually all of the studies pointed to two problem areas: (1) much of the R&D that was being done by the newly emerging institutes seemed to have very little potential payoff within their economies; and (2) a lack of management, as opposed to technical capabilities, existed within many of these organizations.

Turning from problems to solutions, a technique that was mentioned repeatedly during this period was to establish linkages between what were viewed as successful industrialized organizations and developing country institutions. It was within this context, that AID established this experimental program six and one-half years ago. Three major elements comprised the program: (1) a grants program that was aimed at encouraging institutes to conduct R&D in areas that had a significant

potential to pay off in the social and economic environment within which they existed; (2) an R&D management development program directed toward discovering ways of increasing R&D management capabilities in developing nations; and (3) a linkage program to strengthen R&D organizations in developing countries. Successes and failures occurred in all of these program elements, and it is the purpose of this conference to share this information and synthesize new meaning from it.

Events do not occur in a vacuum, and the DRI international program has been carried out through the efforts of the participating institutes, the University of Denver, and the entire Denver Research Institute. Therefore, the first presentation will briefly describe the overall international program of DRI. Following this, the linkage experiment will be presented, and the directors of the three institutes with which DRI believes it has formed successful linkages will describe the role that their institutions play within the development of their country and how linkages have assisted them in these efforts.

The next day of the conference will focus on the four major elements of the linkage activities, which include staff development, information services, technical assistance, and women in development. In these areas, issues and problems, lessons that were learned, and possible future directions will be discussed. The two other topics to be considered during this session will be R&D management development and the grants program.

The final day of the conference will be devoted to a general description of linkages. These will be compared with other mechanisms for aiding the growth of science and technology in developing countries. Finally, a session will deal with second-generation linkages.

During the course of the conference, at least half of the time will be devoted to participant discussion and analysis. It is anticipated that the contributions of the participants will be significant for the field of development science and technology.

THE OFFICE OF INTERNATIONAL PROGRAMS
AND THE DRI LINKAGES

Donald Evans
27 November 1979

The purpose of this presentation is to provide an overview of the Office of International Programs (OIP), including projects related directly to the OST-sponsored contract as well as offshoots of DRI's AID-sponsored activities. This was a dynamic situation in which a single encompassing program under government sponsorship had a number of ramifications. This circumstance demonstrates the importance of supporting R&D institutions so that they can maintain momentum and develop additional activities and outgrowths.

Training activities were of great importance in the experimental program, particularly technology training in specific subject areas, and management training. As an example, capabilities in metallurgy technology were created in one of the training programs. As a consequence of having demonstrated a capability in this technology transfer function, DRI was asked to participate in and help to organize and design a large-scale railroad technology capability in Brazil. A variety of programs related to food and food processing also were of great research interest. DRI staff members are currently working with the Pakistan Council of Scientific and Industrial Research (PCSIR) on a village-level food-processing project.

A number of workshops were conducted during the experiment to promote interaction and cross-fertilization of ideas and easy access to ideas and reactions. To accomplish these goals, the workshops were informal and subjects were far-ranging. One of the topics was institution management. The OIP is in an evolutionary stage in which new or altered directions are being contemplated. One of these is a continuation and emphasis on the training function in management as it relates to science and technology.

The research grants program involved the awarding of dollar amounts to research institutes to perform specific research activities in pursuit of a commercial or applicable end result. Some projects that were funded through this program were not completed, and these will be discussed in later sessions. The reasons for their failure are important to the whole concept of the program.

Finally, the series of linkages between DRI and PCSIR, TISTR, and IIT must be considered as a major program element. One purpose of this conference is to allow the visiting directors of the linked institutes to respond to the questions that DRI has posed for them. Not all of our linkages were directly connected with the OST contract, again illustrating the proliferation effect. Most of the linkages, in fact, were derived through contacts and meetings resulting from this experiment that brought these institutions to the attention of DRI.

This provides just a brief overview of the OIP and the projects involved in the experimental program.

HOW THE LINKED INSTITUTES WERE SELECTED

James P. Blackledge
27 November 1979

The subject of institute linkages has been predominant in the programs that DRI has been conducting under AID/OST sponsorship, and it is important to understand how the linked institutes were selected. Information obtained from my having visited research institutes worldwide was utilized as a basic source. Since DRI is a university research institute, the then new Research Institute at the Middle East Technical University in Ankara was selected to be a linked institute. That linkage failed at the end of one year for a variety of reasons, some of which were political.

The Federal Institute of Industrial Research in Nigeria was chosen to be another linked institute because it was a very small, government-controlled organization. DRI wanted to discover whether or not that type of institution would be an appropriate mechanism for a working relationship. That linkage failed also after about three years due to political, communications and other problems.

The PCSIR was selected because it had a number of laboratories in various locations in Pakistan. At the time, it was predominantly government supported but had a mandate from its government to become increasingly self-supporting. It was not intended that it would become entirely self-supporting but that it would search for financial assistance from industry, governmental entities, and other organizations.

IIT in Colombia was chosen because it had twenty years of experience in contract research and derived at that time almost 70 percent of its financial support from such contracts.

Finally, a linkage was established with the Applied Scientific Research Corporation of Thailand (ASRCT), now called the Thailand Institute of Scientific and Technological Research (TISTR). This organization was chosen because it had not only technological laboratories but also a documentation center. It also had several other service functions that were important to the government and to the industry of Thailand.

As is evident, DRI was choosing different types of organizations with a variety of backgrounds in an attempt to see which linkages worked best and which ones failed; therefore, the program was appropriately called an "experiment." The linkages with the PCSIR, IIT, and TISTR continued throughout the period of the experiment, and the purpose of today's sessions is to hear comments from the directors of these institutes.

THE ROLE OF THE PCSIR IN DEVELOPMENT AND
THE ROLE OF LINKAGES IN ASSISTING PCSIR

Dr. Abdul Ghani
27 November 1979
James P. Blackledge, Chairman

The role of the PCSIR in the development process is currently being debated in Pakistan. It is a crucial topic, but considerable confusion exists among scientists and the government over this question. It seems as if everyone has a different point of view. Concerning the role of the linkage in the development of the PCSIR, it has been very helpful, especially for the PCSIR laboratories.

It is the intention of this presentation to describe the organization of the PCSIR, and the R&D development effort currently underway in Pakistan. It will also describe the various PCSIR laboratories and explain the linkage effects on the PCSIR.

The PCSIR is under the authority of the Ministry of Science and Technology. Other research organizations that work under this ministry include the Council of Scientists and Industrial Research; the Council for Works and Housing Research; the Pakistan Medical Research Council; and the Irrigation, Drainage, and Flood Control Research Council. Of these, the PCSIR is the largest, with about 2,000 people. Scientists number about 500, about 120 of whom are foreign-trained.

Other national research and development organizations in Pakistan are: (1) the President's Secretariat, which encompasses the Pakistan Education Commission; (2) SUPARCO, the upper-atmosphere research organization, and the Defense Research Organization, both of which are under the Ministry of Defense; (3) the National Health Laboratory, under the Ministry of Health; (4) the Agricultural Research Council, under the Ministry of Agriculture; and (5) the Centers of Excellence, under the Ministry of Education, which are supposed to train specialized manpower in various disciplines.

The total R&D budget is about one-fifth of one percent of the GNP in Pakistan. For PCSIR, R&D funding is about 40 million rupees* per year.

The various PCSIR laboratories are located in Karachi (about 600 staff members), Lahore (about 600 staff members), and Peshawar (about 300 or 400 staff members). The total number of divisions and disciplines in these laboratories is twenty-one. The total highly experienced, trained staff is 150. So one can say that 150 senior staff are divided into 21 divisions.

The various divisions of the Karachi laboratories are Agro-Industrial Chemical Research, Applied Physics, and Design and Chemical

* The official exchange rate is approximately ten rupees per U.S. dollar.

Engineering. Roughly five to ten senior people come under each division. The laboratory at Lahore has ten divisions, some of which are Glass and Ceramics Research, Ore Processing and Metallurgy, Industrial Organic Research, and Food Technology. The total number of senior scientists is about fifty for these various divisions. The Peshawar laboratory encompasses the Mineral and Inorganic Industrial Chemicals Research Division, Fruit Technology, Natural Drugs, and Natural Fibers Research. About thirty-two senior scientists work there.

Other projects are currently underway in Pakistan. For example, the Fuel and Leather Research Center has been given top priority but lacks manpower and resources for development. The National Physical and Standards Lab is in the process of being set up. It has been approved, with about a 40-million-rupee budget. The total number of scientists is about fifteen. The Pakistan-Swiss Training Center, which is divided into a Project Division and a Training Division, is doing a very good job. There is a tremendous demand for the technicians from this Center. Additionally, PCSIR has started special projects approved by the Pakistan government. The total funds released so far are 33 million, the total funds spent are 22 million, and the number of special projects is 28. Special projects being conducted at the Lahore laboratories are in the fields of ore processing, glass and ceramics, industrial organic research, food technology, and solar energy. Considerable money is available for solar research at the moment, but manpower is lacking. Similarly, the Karachi labs have certain special projects, including agro-industrial and applied physics research. At the Peshawar labs, minerals research, the production of phosphoric acid and phosphoric fertilizers, and natural drugs and natural fibers research are being conducted.

During the linkage between PCSIR and DRI, various visits were arranged through DRI. The director of the Karachi labs visited the United States for four weeks in 1976; the head of the DRI Electronics Division visited Pakistan for three weeks in September 1976; and the chairman of PCSIR visited R&D institutes in the United States, Holland, and West Germany in July 1977. The director of the Peshawar labs visited research institutes and industries in the United States during August and September 1978. Because of the visit, PCSIR managed to have a very successful international conference on minerals, and a large delegation from the People's Republic of China also participated. An operations research expert from DRI visited Pakistan in July and August 1978. He toured the various organizations, and it was hoped that perhaps a project could be started.

The workshops that were arranged in Pakistan were very popular. Twenty-four scientists participated in the Karachi workshop in February 1976. A workshop on research institute/industry linkages was held one week at Karachi and one week at Lahore, with about thirty participants at each location. The International Conference on Minerals, held at Peshawar, was also a great success. It was the first conference ever held in Pakistan on minerals.

Joint projects between DRI and PCSIR included joint economic feasibility reports on bitterns, fish protein concentrate, bauxite, and

gypsum. The PCSIR-DRI proposal on bauxite was very encouraging, and though PCSIR did not get the contract, it was brought to the notice of the President, who took a keen interest and tried to find out what had actually happened in the awarding of this contract. The PCSIR-DRI village-level food-processing project is currently underway and is proceeding very well. Finally, the use of Know-how Information Services has been a great help to PCSIR for small problems.

DISCUSSION

MR. EVANS: Concerning the bauxite proposal that was almost successful, I would like to tell you what that comprised, because the nature of that collaboration between our two institutions--three institutions, in reality--is perhaps indicative of the direction of linkage development.

An international request was made for proposals to conduct an intensive and exhaustive study of the potential of bauxite exploitation in Pakistan. Under terms of a program supported by US AID, the government of Pakistan solicited proposals to make an intensive study of all aspects of this question. DRI, together with PCSIR and a firm in Golden, Colorado, submitted a tripartite proposal that was notable from several standpoints, one being that it was a true division of labor. It was a joint proposal in that all partners were contributing something of significance, and it was not to be construed in any sense as a tutorial exercise. It was a full meeting of colleagues to undertake a technical effort. The Peshawar laboratories, PCSIR, and the Lahore laboratories, too, have excellent capabilities in minerals exploitation, extraction, and metallurgy, and, of course, an intimate knowledge of the Pakistan situation physically--the occurrence of deposits, the problems of access, transportation, and communications, and labor--all of the basics that decide whether a technical project is actually successful or not. The joint proposal came in second, but it received attention at the very highest levels of the Pakistani government.

DRI has been stressing recently in its activities with its linked institute colleagues the conducting of technology assessments as well as a more complete examination of the implications of the application of technology, looking at the social impacts and the economic effects downstream--the so-called secondary and tertiary effects of the applications of technology. I think that UNIDO has a particular direction and interest in this topic, for example. I do not know where AID might stand, or if that organization has offered any statements with regard to this question.

I would now like to introduce two ideas to be considered in this discussion: (1) the actual joint technological undertakings between U.S. institutes and other countries; and (2) what do we think collectively or individually about the implications, the possibilities, and the necessity to study the socioeconomic impacts of technology, a largely ignored subject.

CHAIRMAN BLACKLEDGE: I am reminded of the project that was undertaken in India a few years ago where somebody conceived the idea of using inexpensive solar cookers to "conserve" the animal wastes, which at that

time were used as cooking fuels, and by which they could then be used for fertilizer purposes. Technically it was an excellent idea. It worked very well. It was easy to cook the foods with these inexpensive solar cookers. They were at a cost sufficiently low that people could afford to buy them. There was one glaring error in the whole experiment: no one considered the fact that the people worked during the daytime and cooked their meals at night. This indicates a very drastic and serious need for societal understanding of the technology that we are trying to transfer into use by people anywhere in the world. If we approach it only from an engineering point of view it is easy--the solutions are simple. But you have to consider the cultural, the economic, the societal effects. Dr. Ghani, has this had a particular impact or could it have on your programs in Pakistan?

DR. GHANI: Certainly. But frankly, a basic problem in developing countries concerns the political leadership. It is impossible to develop S&T programs if their importance is not accepted politically. The political leadership will ask why Pakistan has not become self-sufficient with one-fifth of one percent of the GNP going to national research institutes. This lack of self-sufficiency may then be blamed on the PCSIR. When we try to explain that a project can be attempted only on a pilot-plant scale in a research laboratory and that it may take several years to prove itself commercially, it is believed that industrialists in the country should undertake this type of project on their own. This is a very serious situation.

Similarly, we are not often allowed to leave the country when invited by organizations in a developed country, and I think that this is a general trend in developing countries. Another problem is that research institutes should be made autonomous, but they are now viewed as being subordinate to the government ministry in charge. Also, there is often a lack of communication between the scientific administrator and the head of the ministry.

These are major internal political and economic issues that can be barriers to the development and effectiveness of the R&D institutes. Yet, the government has high hopes for the country's becoming self-reliant within two to four years without realizing the implications of such a goal. Perhaps if there is some collaboration on the S&T effort with the developed countries, we can show concrete results and hence be allowed to exist.

MR. SEWELL: In that light, then, how is the best way to demonstrate to the government that your organization is in fact capable of having a major economic impact? Is it through joint ventures with foreign organizations?

DR. GHANI: Yes, joint ventures. Educating the involved people in the government is also important. There is no reason why the PCSIR should not have gotten the bauxite project. The institute is capable, and the party that got that contract hired PCSIR to test the rocks that they are going to mine.

MR. KITCHELL: The question of linkages is obviously critical, and we need a common understanding of what is meant by linkages. And this question of the economic and social results of R&D work in the list of priorities of problems seems to be putting the cart before the horse. We are talking basically about what we call IRSIs (industrial research and service institutes). A number of the problems facing the IRSIs are solvable by certain actions, by external assistance, while others are not solvable by any such assistance.

The first two problems, and they are highly interrelated, that affect an IRSI's operation are the political leadership and the definition of the role of an IRSI. Some countries have grandiose ideas of what an IRSI can contribute to industrial development, while other countries underestimate the contribution that IRSIs can make. These two factors must be clarified. We all are familiar with the problem of lack of technology and science policy that can be translated into directions for IRSIs.

The third requirement is the means to carry out the functions that have been selected as priorities for a country or a branch of industry. Only then do we get around to the question of whether the particular research project will have socioeconomic impacts.

I think of linkages as performing two functions, but this discussion has suggested to me a third. The first function of a linkage is to build an institution. The DRI-PCSIR linkage basically helped to build staff capabilities to manage and plan research. The second type of linkage involves a cooperative arrangement to jointly carry out a particular function, be it an R&D project or exchange of information for particular purposes. The third function I would like to state in the form of a question. Can any political leverage be gained from linkages with research institutions in developed countries? Or is the political climate becoming such that these linkages may be even the reverse of what we had hoped for? In other words, does dealing with an institution like DRI help you bring certain problems to the political level, or is it better that future linkages be more conventional?

DR. GHANI: A lot of money is currently being put into the developing countries for economic feasibility studies. Usually such contracts go to private consultants, and the private consulting firms in Pakistan are all controlled by retired civil servants who have political connections. Thus, in this area, the R&D organizations are ineffective. My thoughts are that the linkages will be the first step toward getting such contracts, and once we get contracts, we will be technically more qualified than the private consultants. Perhaps the linkages with developed countries will enhance our prestige and help us to get contracts. Once this has been accomplished, we can move into the area of technology transfer. At the moment, nobody in Pakistan assesses what should or should not be imported, or what technology is being repeated.

CHAIRMAN BLACKLEDGE: As Mr. Kitchell has pointed out, very few technology or science policies exist from a practical point of view in very many countries of the world. The United States does not have one. And in fact, very few developing countries have such policies.

DR. GHANI: No, they import technology.

CHAIRMAN BLACKLEDGE: They can import technology, but they have nobody at a sufficiently high governmental level who can influence the policy decisions on what the Minister of State for Science and Technology in Pakistan, as an example, should be doing with regard to PCSIR and to other organizations in Pakistan; is that not true?

DR. GHANI: That is true. The point is, one needs education at the highest level. This is necessary, because the government wants the country to be self-reliant and to develop technology and business; however, officials must be educated about what is involved. They say that the PCSIR has failed but they must realize that PCSIR cannot solve all of the scientific and technological problems.

CHAIRMAN BLACKLEDGE: Perhaps what you are saying is that the linkage mechanism, as we have been practicing it, is at the wrong level, that the linkage should be at the ministry level, not at the research institute level. At least that might be one mechanism.

MR. MOELLER: It appears that Dr. Ghani has two problems. He is trying to convince people on the political level of facts and results, possible results, or a lack of results in an area in which they have no basic knowledge themselves. Second, he obviously is coming to them with a value system quite different from theirs. They consider the political value much higher than the technical or economic value.

Perhaps more effort should be directed toward acquainting the people at the decision-making level with the value system utilized in the operation of the research institute.

I am also interested in the question of introducing technology and having it either rejected or causing changes in cultures and social mores. Where I have worked for the last few years, I have been somewhat dismayed by a fairly significant number of people who think that technology can be introduced into a culture without changing it. They place as a criterion upon the acceptance of a technology that it not change the culture, and that is, I think, an internal contradiction. It means simply that no technology will be introduced. However, once we recognize that the introduction of technology into Pakistan or into any country will cause change in the social, cultural, even the political and hopefully the economic milieu, we should make an effort to understand in advance what this change will be. But we should not say that if technology will cause change, we should not introduce it, because that is an internal contradiction. Yet many people say, for example, that we should not introduce solar cookers because people will have to eat an hour earlier. Perhaps this would bar the introduction of solar cookers, but on the other hand, the change might be perfectly acceptable. We should separate the long-term from the short-term changes in cultures, but I do not think we should say that if it changes the culture, it is foolhardy.

CHAIRMAN BLACKLEDGE: I would like to return to the question as to whether leverage can be gained through a linkage, to ask Dr. Ayala and

Dr. Smith if "advantages" or increased opportunities have resulted from these linkages.

DR. AYALA: I do not consider that a linkage like that between DRI and IIT will have political problems. On the contrary, I consider that we can be a good intermediate local organization to deliberate outside of political considerations.

CHAIRMAN BLACKLEDGE: Dr. Smith, would you comment on whether or not any increased opportunity or leverage for the TISTR has resulted from these linkages? You have had linkages, of course, not only with DRI but with a lot of other organizations. Have these linkages been an advantage?

DR. SMITH: With the DRI linkage we have improved our management capabilities and our ability to prepare proposals for international bidding.

DR. BLACK: Dr. Ghani mentioned that one of the ways that the linkage could help was in overcoming vested interests within a country. Another possible focus for linkage activities is spending more time in informing people outside of the institute how the institute can be of advantage to the country. I would like to give a couple of examples.

In Pakistan we teamed together with PCSIR on a village-level food-processing proposal that was the result of a grant to the Appropriate Technology Development Organization in Pakistan from US AID. The appropriate technology organization wanted to give the contract to an enterprise that was headed by a former politician who had very good political contacts. They were out for financial gain. Although we do not know all the details, it was clear that the head of the appropriate technology organization wanted to give the contract to this private consulting firm in Pakistan.

Upon reviewing the proposal, AID discovered that their proposal was not acceptable. The head of ATDO used what I would say were techniques that were not altogether ethical in attacking PCSIR. But with AID as an honest broker it was possible to overcome vested interests.

For the other example, TISTR and DRI have spent considerable time going to organizations that could potentially utilize the services of TISTR or affect TISTR's income. These visitations included all levels of the National Planning Organization, the Ministry of Agriculture, the Ministry of Industry, and the Ministry of Science, Technology, and Energy. But I do not think that just approaching people in other organizations and telling them that we can accomplish great feats is enough to convince them.

One of the most ideal ways to convince others of your capabilities is to conduct a project that is successful. For example, DRI and TISTR jointly worked on a feasibility study to expand the city of Chonburi out into the Gulf of Siam--a land reclamation project. TISTR did such a fine job that it drew the attention of people within the country who had funds to allocate. The compounding impact of our having spent time with

these people explaining what TISTR could do and having demonstrable success had a strong positive influence on TISTR's ability to obtain contracts from the Thai government.

MR. FRASCHE: Last year when I visited the three linked institutes to administer an evaluation questionnaire for this project, two interesting aspects of the linkage came out vis-à-vis this leverage question. One was internal to the institute in terms of the staff's increased confidence in top management because of the cooperation under the linkage between DRI and that institute. They heard their own management and foreign management espousing the same values and ideas vis-à-vis the institute and its project, and this was important for internal personnel relations. This also increased the credibility of that institute with the government and industrial sponsors. The linkage was evidently important in influencing people's perception of the strength of that institute.

But when I was in Hong Kong last year talking to the Hong Kong Productivity Center about the possibility of establishing a linkage between them and DRI, they were definitely not interested because the purpose of this linkage would have been to promote joint activities within the Productivity Center and DRI in the People's Republic of China. The Hong Kong Productivity Center was reluctant to enter into a linkage agreement with us at that time because they felt they did not want to be aligned with any one particular country, either the United States, Europe, Asia, or anywhere else, in the event that the political situation with the P.R.C. changed vis-à-vis us and others.

In terms of leverage, we are subject to the same vicissitudes in foreign policy as are those involved in other kinds of international relations. Our leverage is a direct function of the political stability of relations between our country and the country of the linked institute.

MR. MOELLER: In looking at the performance of joint endeavors, is it more advantageous to have the linked institute perform the management function, with the linkage largely in the support role, or is the reverse of this more advantageous? Or is this variable depending on the situation?

DR. BLACK: I think that it very much depends upon the moment. In the case of the village-level food-processing project, we originally proposed that DRI be the prime contractor. One of ATDO's first responses was, "No, we are not going to go with a foreign organization being the prime contractor; it must be a local organization." So we said, "Fine." PCSIR became the prime contractor, and we became the subcontractor. After this happened, the director of ATDO said, "No, I do not trust PCSIR. I will not give the contract to PCSIR unless DRI becomes the prime contractor." So again we switched back and agreed that DRI would become the prime contractor.

A second example is the feasibility study that TISTR and DRI jointly proposed to the Board of Investment in Thailand. TISTR was the prime contractor and DRI the subcontractor, plus a number of other

organizations were to be involved in the venture. TISTR got into the finals and was the only non-U.S. organization to do so. After the contract was won by a U.S. joint venture, we were told by the Board of Investment, "Look, we are conducting feasibility studies for setting up new industries in Thailand. We are trying to get outside investment from other countries. Now, who is going to be more believable, a U.S. firm or a Thai firm?"

So the very fact that TISTR was the prime contractor in that proposal had a negative influence on the Board of Investment, because their objective was to try to sell these projects to foreign investors. I think that the role of the linkage depends on the project, its objectives and the motivation of the people offering the contract.

MR. MOELLER: The question of leverage can be interpreted broadly, which we are doing now. It can mean leverage with, for example, the government of Pakistan--the decision makers at the ministerial level--which is, more or less, an internal type of leverage. I think that the most significant type of advantage you are trying to create is that of credibility. I understand why the management function is switched back and forth from project to project, but you primarily want to emphasize the lead of the local organization in order to enhance credibility. If for instance, PCSIR is the prime contractor and successfully completes a project, their credibility will be greater than if the roles had been reversed.

CHAIRMAN BLACKLEDGE: I would like to footnote the comment about the village-level food-processing project. This was a four-phase program, and DRI was the prime contractor during the first three phases. But it was agreed that during Phase 4, which is implementation, the PCSIR would become the lead institution. So even within one project, we are seeing the switch from prime leadership to subsidiary on the part of DRI in the final phase. I think that this is a very healthy situation, because it means that PCSIR in the eyes of ATDO and its present chairman has achieved a certain amount of prestige and respectability that it did not have two years ago.

MS. ACHMAD: I am interested in Dr. Ghani's comments on the lack of political commitment by a government, and I think that this is true not only in Pakistan but all over the world, especially in developing countries. This has been manifested in the U.N. Conference of Science and Technology for Development.

The program of action comprises three parts, and the first part, which I would like to discuss, is increasing the national capability in science and technology. This consists of developing a national science policy, and this involves political commitment by the government. In this context, I would concede that linkages are one of the very important means to improve national capabilities. Foreign institutions from developed countries can play an important role in increasing the credibility of the national institute by convincing the government and private enterprise that the research institutes can occupy an important role in development. This can best be done by developed countries because they can say, "We have proven this."

This, I think, has been proven also in Indonesia. I have been associated with DRI in cooperation with the Indonesian Institute of Sciences, and in many of the programs we tried to inform people from the various governmental policy-making bodies of the value of science and technology and its good management. In the beginning they were reluctant, but after some time they began to enjoy being a member of the group in which we discuss how we can improve or make the maximum use of science and technology for development.

In this respect, the linkages can be useful in achieving this world program of action, which gives top priority to the national political commitment for the role of science and technology in development.

MR. KITCHELL: This raises an interesting problem regarding leverage. One of the problems is political leadership and support and the role of an IRSI. When I was listening to Ms. Achmad, I got the impression that she conceived the institutes as being more helpful at the policy level, and it seemed that Dr. Ayala perceived the IRSIs in a much more practical manner. When we get to the technology transfer and adaptation levels, we are dealing with the guts of technology, not with the rhetoric or the policy.

This, I think, is probably one of the most serious problems with IRSIs--their inability to describe what they are going to do even if they have complete freedom to select priority objectives within an institutional time frame. In brief, they spread themselves so thin that they never get the critical mass to do anything from a feasibility point of view.

Perhaps an outside institution can help to point out that these institutes cannot do everything, and they cannot do it overnight. Priorities must be established, and one priority perhaps should be the development of staff. If the country is committed to developing its indigenous capacities, maybe its major output will be scientists or technicians who know how to work on technology adaptation problems.

MR. MOELLER: This puts you right on the horns of a dilemma, which is, how do you create a broad-based commitment from the political sector unless you appear to be serving that broad base at the same time? And in trying to do the service, you spread yourself so thin that you cannot accomplish your goals. So how do you bring about a political commitment to this sort of a long-term effort that does not require a subcritical fragmentation of the effort itself? I do not have the answer, and the United States certainly does not have the answer.

MR. SEWELL: May I pose a question to Dr. Ghani? If you were master of your own fate, what would you do to correct the situation now?

DR. GHANI: PCSIR should be made an autonomous organization with the president of Pakistan at the top. That is the only way our organization can become effective within the limitations that are important to the system. The only man who can make a direct decision and get it implemented is the head of the state, and unless he has control of science and technology, not much can be done. This was done in India.

There also should be a committee that could assess the work you have done every year. There is nobody to assess our work at PCSIR. Once a year the committee should meet, and the president should participate and hear about the linkages, about our programs, and about our priorities.

MR. MOELLER: The solution that Dr. Ghani has put forward for Pakistan is also the solution that is found to be most acceptable within large corporations in the United States. The research and development arm, which is usually a very small part of the larger organization, reports almost directly to the head of the organization, and this is the only way to make it effective within the corporation as a whole.

DR. GHANI: Another point that is perhaps common in most of the developing countries is that all the research and development organizations are more or less social welfare organizations. There is tremendous pressure on the head of the organization because of unemployment. A main political concern is that certain people be given appointments to the institute. Politicians are concerned with the recruitment of their own men and women. I am sure that this is common in most developing countries.

MS. ACHMAD: I want to comment that there is really no one solution. But it is important that we all learn from one another what are the problems. The institutes in developed countries that work with the developing countries must realize all of the barriers and difficulties. You simply have to make decisions depending on the existing situations or problems.

There is no one solution, but there are similar problems. Probably it is not possible even to assess the same point in the same way--it depends on the governmental structures. The one general problem, however, is the lack of political commitment. How this can be changed varies, depending on the level--institutional or governmental--with which you are dealing. Therefore, it is very difficult to come out with one common solution. Solutions will vary from country to country.

[This concludes the discussion accompanying the presentation on the role of the PCSIR in development by Dr. Ghani.]

THE ROLE OF THE THAILAND INSTITUTE OF
SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
IN DEVELOPMENT AND THE ROLE OF LINKAGES IN ASSISTING TISTR

Dr. Smich Kampempool
27 November 1979
James P. Blackledge, Chairman

The Thailand Institute of Scientific and Technological Research, formerly called the Applied Scientific Research Corporation of Thailand (ASRCT), was formed about fifteen years ago by the government of Thailand. Initial support for TISTR was provided by the United Nations, first under UNDP and later under UNIDO. These organizations provided experts, fellowships, and equipment.

The government had realized the need for a research institute to improve industrial and agricultural products and consequently the need for the nation to become competitive in the world market. Therefore, TISTR was established with the following objectives:

- to initiate, carry out, promote, and support scientific research and investigation in connection with, or for the promotion of, any matter affecting national development, the natural resources, industries, and administration services of the kingdom, including the health and welfare of the Thai people, and to promote the application of the results of applied scientific research for the benefit of the nation;
- to train scientific research workers;
- to provide a central service for making scientific tests and measurements of all kinds; and
- to provide scientific documentation.

The general office of TISTR was set up at Bang Khen on four hectares located next to Kasetsart University. The organization was small at the beginning, with only about fifty employees. The organization had three major divisions: the Technological Research Institute, Central Services, and the Thai National Documentation Center. The following year, TISTR was reorganized into the Technological Research Institute, the Institute of Development, the Agricultural Research Institute, and the Environmental and Ecological Research Institute. Three years later, the Centre of Thai Reference Collections, the National Building Research and Development Centre, and the Instrument Repair and Calibration Centre were added to the organization.

About six months ago, the government affirmed the importance of science, technology and energy and established the Ministry of Science, Technology, and Energy, composed of six governmental agencies. These include: the National Research Council; the Scientific Services Department; the Nuclear Energy for Peace Department; the Environmental Department; the National Energy Administration; and TISTR is the sixth organization attached to the new ministry.

Accordingly, a law was enacted to support TISTR. In the new act, TISTR was given more responsibility in conducting basic research in

addition to carrying on its previous work. Consequently, TISTR was again reorganized to meet the new assignments. The board of directors, formerly composed of five members, now has eleven members. The governor acts as chairman of the board. TISTR now reports to the Ministry of Science, Technology, and Energy and is divided into two major departments: (1) the Technological Research Department and (2) the Scientific Research Department. Both departments are headed by a deputy governor. The Technological Research Department is composed of four divisions: (1) Industrial Research; (2) Building Research; (3) Environmental and Resources Research; and (4) Agricultural Product Development. The Scientific Research Department also comprises four divisions: (1) Natural Products Research; (2) Pharmacy Research; (3) Ecology Research; and (4) Agricultural Research. Also under this department is the Office of Scientific and Technological Services, which is divided into the Scientific and Technological Information Division, the Testing and Standard Division, and the Social and Economic Feasibility Study Division.

The Administrative Office is supported by the Office of the Governor, which also includes the Policy and Planning, and Project and Monitoring Sections. Another supporting role is the Office of Central Services, which is composed of the Finance and Technical Services divisions.

The staff of TISTR has been continually growing, from about 50 members in 1964 to 464 members in 1979. The educational backgrounds of TISTR personnel vary. Some hold Ph.D. degrees, others hold Master's or Bachelor's degrees, while still others have vocational certificates, high school diplomas, or lower school diplomas. Staff members serve as research officers, experimental officers, service officers, technicians, or as assistants.

Most of TISTR's income comes from the government. In 1978, \$32 million was provided by this source. Foreign aid was obtained more or less through contract research, and \$2 million was earned through contracts from within the country.

TISTR's aim is to be a contract research institute, which means that the organization is trying to increase its earnings as much as possible. The target, an ambitious one, is to accommodate 70 percent of all expenditures, but it will take some time to meet that goal.

Linkages have been established with several organizations, namely, CSIRO of Australia, ETR of Japan, and DRI of the United States. TISTR lacks a capability in technical and project management, and hopes to gain considerable expertise in these areas through the linkage with DRI.

Projects that have been completed by TISTR include:

- The pelletizing of cassava flour. Exporting cassava flour to Europe was a problem because the flour created dust pollution in the receiving countries. Consequently, the Thai government sought some means to transport the product without disturbing the environment. Hence, TISTR developed a process for pelletizing the flour that has been successful.

- The establishment of a nursery block factory. Nursery block is composed of agricultural waste from coconut bark.
- A paper and pulp factory is under construction.
- The production of baby food from local raw materials such as vegetables and bananas has also been introduced in an attempt to reduce imports from foreign countries. Cassava flour has also been successfully substituted for wheat in the production of baby food.
- One cosmetic industry has been established.

The activities that were completed during the DRI-TISTR linkage include the following:

- One senior research officer of TISTR was invited to participate in a workshop on "Management of Industrial Information" at DRI from 2-31 May 1974.
- A workshop on "Effective Linkage between the Research Institute and Industry" was hosted by DRI and TISTR at Bangkok from 8-19 July 1974.
- TISTR received a grant from DRI to conduct research on the use of rubber seed oil for a paint base in 1975. The grant was for \$27,000 and furnished equipment and parts.
- Two senior research officers of TISTR were invited to participate in a workshop on "Management Development" at DRI from 22 September - 10 October 1975.

Both organizations felt that the activities were narrow in scope. Eventually, a direct linkage was established, and a Memorandum of Understanding was signed in December 1976. The general goals of the program were:

- to create useful and productive employment in rural areas;
- to increase the level of income in rural areas; and
- to increase the skill level in rural areas.

To achieve these goals, TISTR received assistance through the linkage in the form of training and study tours as follows:

- Two staff members of TISTR received long-term, on-the-job training and study toward a Master's Degree at DRI and the University of Denver. One staff member graduated in March 1979, and the other is still training at DRI.
- One TISTR staff member received information users' training at Washington, D.C., and a study tour on computer search information at Denver.
- One senior staff member received short-course training on women in development at Washington, D.C., and DRI.
- A top executive of TISTR visited Washington, D.C., and DRI for a study tour.
- A senior staff member visited the Philippines and Indonesia on a study tour of integrated development projects.
- Two TISTR staff members visited KIST in Korea to conduct a feasibility study for transferring high fructose syrup technology to Thailand.

In addition to the study tours, a number of workshops were conducted. These included:

- A workshop on effective linkages between the research institute and industry, held at Bangkok from 8-19 July 1974.
- "Alternative Approaches to Effective Contract Activity" workshop held at Pattaya from 30 August-8 September 1976.
- "Increased Utility and Utilization of Applied Research Institute through Regional Networking" workshop held in Indonesia from 14-24 September 1978.
- Three management workshops: (a) the "First Project Management" workshop was held in Bangkok from 6-16 December 1977; (b) the "Institutional Management" workshop, held in Bangkok 10-14 July 1978; and (c) the "Second Project Management" workshop, held at TISTR 8-15 December 1978.
- Women in development workshops: one was held in 1978, two in 1979, conducted through the assistance and cooperation of the National Women's Council of Thailand.
- The TISTR/DRI seminar on "Use of Scientific Information," held at TISTR 4-8 September 1978.

DRI also provided expert consultants, who assisted in the following areas: packaging technology, information services, cost-benefit analysis of a Chonburi land reclamation project, proposal writing for Board of Investment, contract research, management, and support generation from funding agencies.

Another objective of the linkage was to establish technical cooperation among ASEAN countries. The goal was to strengthen the regional technological capability in order to effectively carry out contract activities for regional industry. The transfer of high fructose syrup technology from KIST to Thailand is one example of this type of cooperation.

Both direct and indirect benefits have resulted from the DRI-TISTR linkage. Several key staff members of TISTR have been upgraded in their capabilities and status, and this achievement has been felt also by the government and industry. For example, for 1979 and 1980, TISTR has been granted contracts both from the government and private industry as a result of our increased capabilities and status. Another benefit will be realized if a network of applied research institutes is established in the ASEAN region. This has been partly accomplished but will require more time and resources for complete actualization.

A considerable increase has occurred in recognition of TISTR's status by key governmental agencies, such as the National Economic and Social Development Board, the Board of Investment, and the Industrial Finance Corporation of Thailand. TISTR senior staff members serve on all major committees of NESDB. Last year TISTR was represented in the technical committee for the ministerial level meeting with foreign counterparts. TISTR also has been asked by the Ministries of Industry and Commerce to conduct research and development that will help the cassava processing industry.

Future assistance through the DRI-TISTR linkage could be provided in these areas:

- The design for the expansion of the physical facilities (the Japanese government has been asked for assistance in the actual physical expansion process);
- R&D management development (this would involve assistance from DRI in training additional TISTR staff who could conduct training independently from DRI);
- Industrial consultancy services. With an expert providing technical support, TISTR might obtain more contracts from the government and private industry;
- The promotion of technology transfer; and
- Energy research assistance.

DISCUSSION

MR. KITCHELL: I would like to ask Dr. Smith to elaborate on his fourth point, technology transfer.

DR. SMITH: Technology transfer is to help strengthen the capability of the National Center for Technology Transfer. Currently, a technology transfer unit is attached to TISTR. We would like to make it the Center for Technology Transfer of the country. In doing so, our staff needs to be trained in technology transfer.

CHAIRMAN BLACKLEDGE: TISTR's Thai National Documentation Center (TNDC) is being converted, as I understand, from performing principally a library function to providing know-how information services and assisting the transfer of technology vis-à-vis information to industry, government, and so forth.

DR. BLACK: As a point of clarification, ESCAP has suggested that national technology transfer centers be established in member countries. A committee in Thailand is trying to decide where such a national center should be located. Many people think that it should be within TISTR and that TNDC should serve as the center. Perhaps it is Dr. Smith's contention that the center should indeed be located at TISTR and that TISTR would like to start developing the capabilities to make this a reality.

Regarding the training, TISTR could be assisted in restructuring TNDC such that TNDC could serve as the nucleus of such a center, in identifying what other capabilities are needed, and in helping TISTR to train its staff to develop such capabilities within the organization.

However, has the committee decided that the center should be located at TISTR?

DR. SMITH: It has not yet been finalized, but the intention is to make the center TNDC, because TISTR already has the facilities.

MR. KITCHELL: So the National Center has not yet been created?

DR. SMITH: No.

MR. KITCHELL: Will TISTR indeed be a good location for a national center of technology transfer?

DR. SMITH: Yes, TISTR's location is quite suitable to be the technology transfer center. Of course, even when new facilities are completed, TISTR will still maintain the present site.

MR. KITCHELL: My reason for asking this is because in the UNDP/UNIDO study of research institutes, the question of whether research institutes or research and service institutes should move into technology transfer work was very important. A number of steps are involved in technology transfer. The technology must be selected, adapted, and negotiated, and not all of those functions should be performed by the research institutes. Which ones should be under the control of the research institutes would vary depending on the country and the situation. I was just suggesting that if TISTR has been traditionally oriented more toward research, the industrial knowledge that is required to recommend technology may not exist or may not be in a form that is readily usable.

MS. LUCAS: Dr. Smith, how do you envision the functions of a national transfer of technology center for Thailand? What jobs would such a center perform?

DR. SMITH: One function would be adaptation of foreign technology. For example, if Thailand wanted to set up a pulp and paper factory, machinery could be imported. The merit of having the national technology transfer center attached to TISTR is that TISTR could help to modify local raw materials as well as modify the machinery to suit local conditions.

MR. MOELLER: So TISTR is now actually moving more toward development than research, by definition.

DR. AYALA: We need to clarify what transfer of technology means, because sometimes we only negotiate a transfer of technology. An institute like IIT transfers technology in a general way. Of course, IIT is now trying to devise additional technology transfer activities.

First, we would like to know what alternative technologies we can find in the world for solving some specific problem or for starting a new industrial operation. When we receive the information, we need to select according to local conditions. Therefore, we need to assess the different facilities for alternatives. The negotiation process follows, with its accompanying political, economic, business and technical problems. Our institution also contributes toward some of these activities.

Regarding the adaptation of technologies to local conditions, IIT is starting to manage this complicated process quite well. However, we need to think not only in terms of the technology, but about buying or paying for royalties. In this aspect, our institute contributes significantly to the development of our country.

DR. GHANI: In Pakistan, it has also been decided that a national center of technology transfer should be established. First, it was considered that PCSIR should be the center, but then it was considered that the center should be directly under the Ministry of Science and Technology. In my opinion, the research institute, although it may not be as competent as it should, is the only organization that is capable of assessing technology and determining the rate of technological transfer.

CHAIRMAN BLACKLEDGE: One could start a very provocative argument over this issue. In the case of Thailand and Pakistan, for example, do other organizations exist that could host the technology transfer center? Perhaps we would all agree that until now, the existing institutes have focused more on research than on development. But is it not possible that the location of these technology transfer centers has caused the emphasis to shift more to development? If not, where are these technology transfer centers going to be located? In Pakistan, will the center be under the Ministry of Science and Technology, which does not have as much expertise concerning technology? Do you create a whole new infrastructure in a system in which you are short of human resources, or do you use the existing resources and try to re-train them, to redirect them to perform these functions?

MR. KITCHELL: Another variable can be added to what you are saying. I am afraid that the national centers are an organizational panacea for more difficult problems. The technology transfer steps are quite detailed. Some of them, all other things being equal, should be performed by an IRSI.

In our study, we classified technology transfer, and the steps that we thought could be handled by an institute were broken down into three major categories: information on selection of technology; acquisition and application of technology to be transferred; and, equally important, maintaining, supporting, and further developing transferred technology. Each one of these is broken down into a number of steps. Obviously, an IRSI could play a major role in obtaining information on a desired technology. However, only technical and technoeconomic inputs will probably come from an IRSI concerning selection of the most desirable technology.

DR. AYALA: Why are you only saying technical and economical?

MR. KITCHELL: I will amend that and add social. But the point I am making is, there are a number of rather distinct steps, although some overlap occurs. IRSIs have no business being involved in some of the steps. In the case of your institute, for example, emphasis should be on adapting existing technology rather than inventing new technology. Naturally, this is my own opinion. But what do you have to give up to move into this area?

DR. GHANI: This is true - our institute is thinly spread. At the same time, I do not think that certain research projects are as productive as they could be. Perhaps if technology were properly selected, it could have more economic impact than the research problems being worked on at the moment. From the country's point of view, if we shift the emphasis to development, it will be in the national interest, because that is where the money is. Some research problems have continued for ten or fifteen years - something has to change.

MR. SEWELL: Dr. Smith, as a matter of organizational information, could you elaborate on the role that your economic and marketing analysis group would play in establishing priorities for your institute?

DR. SMITH: This group would help us draw up a feasibility study for a research project.

MR. SEWELL: Would it explore, independently, opportunities for a new type of product or process?

DR. SMITH: Yes, market surveys would be conducted by the group to determine what would be needed to create another research project. The surveys would also identify the needs of the country.

MR. MOELLER: Technology transfer is an extraordinarily complex process, and every step cannot be accomplished in any single institute, to my knowledge. The process requires a complex interaction of many different elements. However, one of the few steps in which an industrial research service institute can function well is in technology assessment. Choice, however, becomes very complex, and the IRSI may become more deeply involved than its capability may allow. When it gets into the actual acquisition role function, its role diminishes somewhat. Then, curiously enough, it begins to build up again during the process of adaptation.

MR. KITCHELL: You are speaking in theory, though?

MR. MOELLER: I am speaking in theory, but one has to speak this way for reference purposes because each time you run into the whole profile of a project, it takes on quite a different landscape. Technology transfer is extremely complex. It is a very difficult project to take on with limited capability. In many countries, there is a dearth of competence at receiving technologies and making the necessary choices. It is a general problem but each transfer of technology is an extremely specific application.

MR. KITCHELL: Perhaps why I play the devil's advocate here is because I want to support the IRSIs and see them play a viable role in contributing to their national industrial development. The problem with IRSIs not being involved in technology transfers is probably the reflection of another problem--that they are not involved much with industry.

MR. MOELLER: Recognition of a need must also be taken into account. This can be obtained through market analysis or simply by looking at import data. But the capability to assess the opportunity--to describe

both it and its magnitude--is the capability that I find lacking. It is extremely important very early in the game to be able to identify and assess the opportunities.

CHAIRMAN BLACKLEDGE: But the problem stems back to the creation of the IRSIs, which probably were conceived with the best of intentions by politicians to meet a perceived need but which were not necessarily realistic in their perceptions within their own country or region. IRSIs have a mandate that was established before their doors were ever opened that said they were going to do research. This was the creed under which they were to operate and for which they were funded, and have been funded, and it seems that a real mechanism is lacking for these institutions to change their orientations.

For example, why is the PCSIR involved in electronics research? It seems that the institute would be better off not worrying about traffic lights for Karachi, which admittedly are necessary, but devoting the energies of those people to a project more appropriate to Pakistan's development needs. But these concerns do not enter into the mandate when the IRSIs are established. Therefore, the IRSIs do not have the relationships required to meet the real needs of industry.

MR. SEWELL: Does not all of this really boil down to the selection of staff?

CHAIRMAN BLACKLEDGE: No.

MR. SEWELL: I think a large part of it does. In my experience, the ability to perceive needs of industry and to determine appropriate technologies requires staff members trained in specific areas.

CHAIRMAN BLACKLEDGE: But if you establish a table of organization that requires three electronic engineers, two chemists, five physicists, and two microbiologists, you have preconditioned the circumstances under which that institute is to operate.

MR. SEWELL: That is true, but is it not possible to have industrial consultants who are capable of conducting on-the-scene application work? What do you think?

CHAIRMAN BLACKLEDGE: If the situation were Utopian, and no institute opened its doors until industry's needs were clearly recognized, catalogued, and quantified, and if staff were selected on the basis of those needs, the situation would be very good.

MR. SEWELL: I do not understand why an institute cannot have both its research staff and its field people who have some hardcore industrial experience and who can sense what it is like to work in an industrial environment.

MR. MOELLER: That is a good question. I bet you get three answers that are going to be very similar.

CHAIRMAN BLACK'EDGE: I think you would get a different answer from IIT, which has to obtain 70 percent of its operational income from contracts, and from PCSIR, which obtains maybe 10 percent, and from TISTR, which obtains about 4 or 5 percent. At IIT, the staff are motivated to a certain extent by continuation of employment. They are not tenured and have to survive by their wits.

MR. KITCHELL: Another variable applies here, too. The more that is contracted, the more the inscstitute is directed toward real needs rather than conceived needs.

MS. LUCAS: Does that come from a mandate, or is it a relationship that has developed over time?

CHAIRMAN BLACKLEDGE: I think some of each.

MR. MOELLER: I think that a mandate can sometimes prevent effectively moving to the contract status.

Dr. Smith, does TISTR have authority to assess the resources in Thailand--to determine what resources are available--or to provide input into industries?

DR. SMITH: TISTR has done that in the field of building materials.

MR. MOELLER: So you do see assessment as part of your function?

DR. SMITH: This is very essential, I think, to formulate any research project. Otherwise, if it is too much an in-house project, it cannot be implemented, at least in the near future.

MR. MOELLER: I was thinking specifically of mineral resources. Do you have the direction to determine what mineral resources exist in Thailand, or does that authority reside elsewhere?

DR. SMITH: The prime responsibility for minerals assessment lies with the Natural Resources Department, but TISTR supplements the work of that department.

MR. MOELLER: TISTR also has the responsibility for standards?

DR. SMITH: Yes.

[This concludes the discussion accompanying Dr. Smith's presentation of the role of TISTR in development.]

THE ROLE OF IIT IN DEVELOPMENT AND
THE ROLE OF LINKAGES IN ASSISTING IIT

Dr. Jaime Ayala R.
27 November 1979
James P. Blackledge, Chairman

The Institute for Technological Research (IIT) is an autonomous, nonprofit institute that was established in 1958. IIT has linkages with both the government and the private sector. Institutional sponsors, which are represented on the board of directors, include the Bank of the Republic, the Agrarian Bank, the Colombian Petroleum Company, the Federation of Coffee Growers, and the Institute for Industrial Development. The government, the private sector, bilateral cooperation, and international institutions also sponsor specific IIT projects.

The general goal of IIT is to contribute to the improvement and modernization of technology, with emphasis in industry and in agricultural products, which includes the processing of agricultural products as well as the manufacturing of products used by the agricultural industry.

Three general areas of activity are developed at IIT: applied research, industrial services, and industrial development in general. Of course, all activities are directed toward industrial development, but applied research concerns such areas as the development of new products and processes and the solution of production problems. Industrial services encompass the areas of quality control, pilot plants, technical information, and technological assistance. Industrial development involves seeking new investments in the development of industrial products in regions or in sectors, conducting feasibility studies, and, in some instances, engineering projects.

IIT has a total permanent work force of 135 Colombians. Sixty are professionals with different degrees in different disciplines. Depending on IIT's activities and projects, specialists, national or foreign, may complement the permanent staff.

IIT serves national, state, and local governments. It also works with the private sector--either individual firms or groups of industries--and with foreign organizations, either private or governmental. IIT's main areas of activity are in the food, metallurgical and mechanical, and chemical process industries.

Most of IIT's work is in the form of contract research or studies. The institute receives requests, prepares proposals, and presents them to prospective clients or institutions. If the proposal is accepted, a contract is signed, and IIT executes the study and presents the report.

Almost from the beginning, IIT has been administered by a system of projects that charges costs. Sometimes IIT has been subsidized for small- and medium-scale industries. The institute is now receiving a specific contract from the Bank of the Republic, which is subsidizing IIT's services to small- and medium-sized industries. In general,

subsidies pay between 20 or 30 percent of the total cost of IIT's services. From this, 70 or 80 percent is taken to pay administrative costs. For some studies, IIT has cosponsors, such as banks or financial corporations that extend lines of credit.

Regarding the role of the IIT in development, sometimes the country, the institutions, and the people have large expectations. IIT tries to serve these needs by contributing in five general areas.

The first is science and technology policies and planning. Of course, this is an indirect function, but IIT believes that it should assist the organizations that are directly in charge of this type of activity by participating in the advisory committees, particularly in the Colombian Science and Technology Foundation. For example, IIT participates in committees that provide advisory assistance in the areas of food and nutrition, natural products, pollution, and energy. Government ministries also have advisory committees and councils. The Ministry of Development has a National Council for Standards and Quality Control, and IIT is a member. Recently, the ministry nominated a national committee to prepare a program on the use of alcohol as an additive to gasoline. IIT is also involved in this activity.

The second area is advisory services to national institutions. IIT is now serving, for example, the National Planning Department and the Ministry of Development. In the Ministry of Development, IIT is working in sectorial programming. Also, IIT interacts with the superintendents for industry and commerce, whose organizations, under the Ministry of Development, register all transfer of technology contracts, if they include royalty payment. These organizations also have a special committee in which IIT participates occasionally in order to assist in technological aspects of contracts. In addition, the institute gives direct advisory services to superintendents for quality control and standardization.

The third area of IIT's activity is national government problems. About four years ago, the Colombian government started the National Program of Food and Nutrition (called PAN, which means "bread" in English). IIT has participated both directly and in an advisory capacity in this project. The Colombian government has also nominated IIT as the national representative in developing a food and nutrition program directed toward regional problems in the general Andean area. IIT, as a member of the Andean group, will work with representatives from other Andean nations in solving problems in technological development. Another program in which IIT is involved is the development of a coal technology laboratory. Research is being conducted in coal preparation, coal briquetting, coal processing, and other aspects of the coal industry. Environmental problems, especially water pollution and waste disposal, are also being addressed by IIT.

The fourth area of IIT activity is in the advisory services for both existing and developing industries. Specifically, IIT has worked with existing industries in rural areas in brown sugar (panela) production and in fruit processing. The institute's activities have been directed toward industries of all sizes. IIT is also conducting

regional and sectorial studies in order to identify new industrial development and to promote IIT developments.

The fifth area IIT calls technical services in general. These include, for example, technical information service and quality control for raw materials and their processing.

The DRI-IIT linkage has been useful to IIT in the areas of information, training, consultancy, grants, and equipment procurement. IIT has received, for example, information about technologies, institutions, experts, and technical training in other institutions. Three technical workshops in foundry and packaging technologies and quality control of foods were conducted. IIT would like to develop another workshop on the quality control of foods that would be conducted by both DRI and IIT. The goal of the training session would be to present to industry specific problems and how IIT can contribute toward solving these problems.

IIT also attended workshops on project management and information services. Members from other institutions also participated. Representatives from IIT's sponsor organizations were invited to the project management workshop because IIT wanted them to understand why the institute charges the fees that it does. The workshop helped to explain the high costs of research. People from outside IIT were also invited to the information workshop, and this helped them to understand why IIT has to charge for services. Governmental agencies in particular dislike having to pay for information services, and the workshop explained why such a system is necessary.

DRI provided excellent consultants, particularly for the coal technology and brown sugar production programs. IIT also participated in two projects of DRI's grants program. The first concerned pollution control in connection with the National Petroleum Company, and the second focused on the precooking of grains and flours in the preparation of spaghetti. IIT is currently preparing a specific proposal for the development of a prototype machine.

A flexible plan of operation is important for IIT's programs. DRI's assistance has been valuable in providing such flexibility. It has allowed IIT to prepare detailed plans of operation, to take time in discussing and further developing plans, and to make necessary changes.

DRI also provided important assistance in procuring small pieces of equipment. For example, DRI obtained a bottle of chemical reagent that IIT needed for an analysis. If IIT had tried to obtain this in Colombia, it would have required five or six months and hence would have slowed research activities considerably.

IIT's coal technology program also benefited from two excellent consultants obtained with the help of DRI. Through this assistance, IIT was able to begin operation of a pilot plant for coal processing and recovery of byproducts from coal carbonization. Study tours made to the United States by IIT staff members have also proven useful. Although most of these visits were of short term, they helped to solve some very

specific problems. As an example, four of IIT's technical staff were sent to different institutions to obtain the correct methods of analysis and control in regard to the Cartagena Bay water pollution problem. Thus, consultancy has played an important role in augmenting the programs of IIT.

DISCUSSION

MR. EVANS: The problem of cost is persistent, and it is probably just as much a factor in DRI's contract research investment in the United States as you suggest that it is in Colombia. What do you feel the trend is among your sponsors and potential sponsors with regard to accepting the cost that R&D requires and entails? Are they becoming more realistic, or conversely, are they as resistant or more resistant to paying the demonstrable cost of the service?

DR. AYALA: IIT now tries to explain in detail the specific services that it offers as well as the way it costs the project. I think that this is a process of educating our sponsors and potential clients. Possibly in this way they can understand and accept the costs of research.

CHAIRMAN BLACKLEDGE: I have always been impressed by the fact that industry uses attorneys for legal assistance and public relations firms for advertising and promotion, usually without much question of the cost. But when it comes to providing technical services, they begin to ask, "Why do you charge these ridiculously high prices?" It is an interesting anomaly.

DR. AYALA: Sometimes I like to compare, also, IIT with external research institutes, which might charge ten to twelve thousand dollars per month. If we charge only two or three thousand dollars, possibly local organizations can start to appreciate the value of local services.

In one of the project management workshops, participants, especially the project leaders, could compare the costing in DRI and in IIT. This was beneficial, because sometimes the project leaders also say, "Why this very high overhead?" They need to understand, for example, that my salary has to be paid, other salaries have to be paid, we need library services, shops, the building, and general services. When people from outside IIT attend workshops, they begin to understand project management and financial resources management. They begin to realize that you have to earn a high percentage of your budget and that you have 135 people with their families dependent on the earnings of the institute.

MS. FLYNN: Is it ever possible to estimate the cost of not solving a problem or not using your research so that it can be compared to the cost of your services? In other words, if a problem is not solved, a cost will be involved, and you have to compare that with the cost of IIT helping to solve the problem. Is this possible?

DR. AYALA: I think that it is difficult. Also, it is a matter of time. Sometimes we have conducted research that could not solve the problem,

or a client did not use our report. Problems concerning development and application of technology take time to solve, especially when you are not in an industrialized country. It takes a lot of work to convince people that the research will be valuable. This is why I do not like the relationship between costs and benefits--it is difficult to apply to this type of work.

MS. LUCAS: What kinds of resources, both in terms of money and people, can you devote to a typical project?

DR. AYALA: IIT's budget for this year should reach close to \$1 million. The amount spent on a specific project varies depending on the size of the industry involved and the length of time required for the project. Some require only one week and one person, while others last for two or three years. For example, the National Program on Food and Nutrition is a project that will take four or five years. The budget is \$70 million for the five years, and it is funded by local money and by the World Bank. Of course, IIT will receive only a small part of this total amount for its participation. IIT is also working as a liaison between the government and private industry in order to produce some of the foods to be used in the national program. The dimensions of the projects are different; some are small, others are large scale.

MR. SEWELL: What kind of cooperation have you received from the Colombian banks? I think you mentioned that they did give you some support.

DR. AYALA: Yes, the Bank of the Republic is one of our institutional sponsors. The Agrarian Bank is another sponsor, and sometimes IIT signs contracts with sponsors for specific services; for example, the specific project for giving technical assistance to small- or medium-scale industries. We cannot use that money to conduct general studies for industry, only to perform specific services for particular industries.

MR. MOELLER: How effective is the method of providing subsidies to small- or medium-sized industries for specific projects?

DR. AYALA: I think that it is effective. For example, some years ago IIT had a specific project with the United Nations for serving small- and medium-sized industries. But the Colombian government was unable to continue its financial support, and IIT had to direct its efforts toward serving large-scale industry, which could afford our services. So now we are experimenting again in this type of subsidy. I think that it is a good operation both for the institution and for the industries, because we can deal with specific problems of the smaller industries.

MR. MOELLER: Who makes the fundamental decision as to whether a project should go ahead and what the terms of the project should be? In other words, who decides that the funding should be split between the specific industry and the bank fund? Also, how do you sell the service? Do you wait for it to be bought, does the bank sell it, or do you sell it?

DR. AYALA: We need to sell every project, and this is generally done by the project leaders, the assistant director, and the director.

MR. MOELLER: More specifically, how do you acquire the small business programs? Do you do the selling?

DR. AYALA: Yes. For example, we have a simple technology for the preparation and conservation of food pulps. To sell the idea of trying this new technology, IIT sends appropriate staff members to the small industries. Sometimes the industries are not interested in our idea, but they might have some other problem and ask us to help.

MR. MOELLER: Do you, or does the bank, decide who has to pay what part of the tab? You said that 20 to 30 percent is paid by industry, but who makes that judgment?

DR. AYALA: We have a special fixed table that indicates the amount that the industry must pay. Every two or three years the table is adjusted according to our costs. The adjustment is made by IIT and the bank. Small industries usually pay a very low percentage.

MR. MOELLER: The basic eligibility for this service support is your determination? In other words, if an industry comes to you, or you go to them, you determine that the project is eligible for service support?

DR. AYALA: Yes. We have also determined some more or less specific types of services; for example, development of a new approach for solving technical problems or problems of quality control. We also consider the size of the industry, according to the assets of the company.

MR. MOELLER: What is the yearly cost of the program?

DR. AYALA: The total yearly cost is now four to five million pesos, or about \$200,000.

MR. KITCHELL: This raises what I think is a very important question. Should an IRSI, which presumably has very scarce human and technical resources, be trying to serve small industries? The problems of small industry are widespread, and you must ask whether they are inviting to the type of staff you want to attract to an IRSI. Also, are they the types of problems that cannot be solved by a different type of organization? This is an interesting question. Let me also ask, how much of your annual budget derives from contract research?

DR. AYALA: It depends on what you mean by contract research. I will put it another way. Most of our problems must be negotiated with the government, with the private sector, and with international organizations. The percentage of our budget that derives from contract research depends on the different types of activities. For example, for the next year the amount of money from international organizations will probably be lower than in the past two or three years, but we will have more money from the government because we are more involved in national programs.

MR. KITCHELL: Do you find that negotiating and justifying your existence every year is making you a more meaningful organization or skewing you away from what you think is important?

DR. AYALA: That is a very difficult question. We need different types of projects, because at times we need to earn the money for the next year. Sometimes we cannot work on projects that require medium- or long-term commitments. For example, let me mention the coal program. Coal is an important resource for Colombia, but in the last ten years we have received only a small amount of money from the Colombian government to support the project. This is now changing. In any event, IIT tried to develop a small laboratory, which is now the only complete laboratory in coal technology. We insisted on this ten or fifteen years ago. If we had been able to establish cooperation and an understanding of the importance of investment in this field, probably the situation for Colombia at this moment would be quite different.

I would also like to mention our two projects with the United Nations--first the one with UNDP and then the one with UNIDO. The program was designed to serve small- and medium-scale industries. With the assistance of U.N. consultants, we prepared a report concerning the creation of a technological development center for the plastics industry. This was six or eight years ago. One year ago we received a new project from UNIDO, but it was for the same program. Over time, the state of the plastics industry has declined, so now industry and government representatives are interested in cooperating in such a project. IIT, industry, the Colombian government, and the United Nations will all be involved. Industry representatives have asked me, "What will be the contribution of the institute?" I replied that IIT will be contributing twenty-two years of R&D experience in addition to governmental assistance. Without the participation of IIT, funding by the government may not be as easy to obtain.

CHAIRMAN BLACKLEDGE: Would you care to comment on your relationship with SENA, the national productivity center in Colombia?

DR. AYALA: SENA is a very big organization that receives 2 percent of the total payroll of the companies in Colombia. The main purpose of the organization is to train workers, to develop manpower, at different levels up to that of supervisor. We are trying to develop more contact between IIT and SENA concerning extension services. IIT can prepare good reports, but we do not have enough staff members to conduct extensive extension work. We are trying to negotiate with SENA so that we can prepare their instructors in some our developments. SENA likes to use our information services. They want to receive this free, yet they receive money, including some from IIT. I have said to them, "You need to pay us for that service."

CHAIRMAN BLACKLEDGE: They have more money than you do.

DR. AYALA: Yes.

MR. EVANS: Are industrial extension services an appropriate function for an institution that has the scarce resources of highly trained scientists and engineers? Are the R&D institutions the logical vehicles for extension services and for the application of "appropriate technology," or does this represent a less efficient use of the intellectual capacity of your institution?

MS. ACHMAD: In relation to this problem, I have another question. Does IIT provide R&D, extension services, and management advice to industry? If so, are you really set up to function in all three areas, or are you forced by the environment to do so? And if you do provide industrial management service, how do you equip yourselves to do so? Does the DRI linkage provide assistance in this area?

DR. AYALA: Yes. Probably we should go into more detail about the services to small- and medium-sized industries. Politically speaking, the country tries to build a simple model for giving technical assistance to small- and medium-scale industries, and it is developed like a pyramid. On one side of the base of the triangle is administrative assistance, the second side is financial assistance, and the third category is technological assistance. This triangle, the basis of the pyramid, links the forms of assistance with the general governmental policies for development of small- and medium-scale industries. If all three elements can be given at the same time, the technical assistance will probably be more effective.

But in a country like Colombia, many small and large institutions are in charge of different activities. So we cannot staff a program of integrated technical assistance to small- and medium-scale industries just in one institution. IIT is working more on the technological side, and SENA is probably working more on the administrative side. A special corporation serves financial needs. For ten or fifteen years, we have tried to coordinate these three elements without much success. Also, according to our mandates, we do not need to participate in activities that other institutions are doing; we prefer to work in new areas.

SENA has a good program in administrative assistance and receives money from industry because of the 2 percent tax on the payroll. This is why we concentrate more on the technological aspect. Actually, I consider technology the more difficult part of technical assistance, because in each industry a high level of expertise is required. Not that administrative assistance is any easier. But in administrative assistance, general principles apply, whereas in technology, aspects may vary from one area of research to another.

MS. ACHMAD: How do you foresee the prospect of coordinating your triangle? Do you have any hope that a national body or government will ensure that industry receives complete assistance?

DR. AYALA: I have continual hopes about this.

CHAIRMAN BLACKLEDGE: Let us move our program along now to the final discussion, which is a comparison of the three linked institutions.

MS. ACHMAD: I have heard about the benefits of the linkage with DRI and would like to hear comments from the three ARI representatives concerning problems during the initiation of the linkage as well as the negative impacts. One problem that can occur, I think, in any bilateral linkage is that one side may be too strong. Do you feel any insistence by DRI to follow strictly their advice or methods, or do they encourage you to gain experience from other countries or institutions?

Other potential problems may be the red tape of both governments in delaying activities, language barriers in conducting workshops, and the possibility that the linkage has limited the opportunity of the receiving institution to obtain assistance from other countries or institutions.

MR. KITCHELL: May I add one more potential problem to the list--unrealized expectations, whether or not they are rational.

MS. ACHMAD: Yes, that is the meaning of my question. At the end of one project, do you feel that you have achieved what you actually wanted? If not, why? If you have, do you think that it could be improved?

MR. EVANS: Is the difference between the relative degree of technical sophistication a problem as well?

MR. MOELLER: Let me add a comment here. It appears to me that there are two aspects to consider. First is the aspect of retrospective view. In other words, you have to look back, realizing now what your position was, in order to look ahead with respect to these decisions. This is one problem.

But another little potential problem appears here, and perhaps it can be highlighted by a theoretical proposition. Suppose that the people who supplied the basic resources to DRI had, instead, supplied the resources to you and said, "You must spend this with DRI but the choice is yours." Would it have been different; and if so, how? Would you have used these resources somewhat differently?

MR. SEWELL: I have another question that is quite succinct. If you had to start over again with the linkage you had, what would you do differently?

MR. MOELLER: If you had to start over again but the money was on your side, what would you do?

MS. FLYNN: I would like to add a comment. My understanding is that assistance works both ways. I am interested in how the ARIs have contributed to DRI's knowledge, which can be shared worldwide or be used in another context.

DR. AYALA: I would like to mention that the linkage has been an experiment. In such a context, all participants in the experiment learn a great deal. We probably still do not have all the answers.

DR. GHANI: Concerning the questions raised with regard to problems of the linkage, I honestly do not think that there were any negative points. It was an experiment. As to the comment that one side was too strong, I think that was the whole idea of starting the linkage--because one side was stronger and could offer the assistance needed by the linked institutes.

I think that the workshops were excellent. PCSIR gained considerable knowledge in management science, which, in my opinion, had

been lacking at the institute. The visits were also useful at all levels. We learned about the latest developments in the United States and gained expertise from U.S. scientists. To answer the question of how PCSIR would have used the money spent on the linkage, probably the government would have used much of it.

MR. MOELLER: Would you perhaps have put more emphasis on the workshops?

DR. GHANI: No. I would like to emphasize collective efforts on cooperative projects. These would have more economic impact, which is very important. It was because of DRI that we got the food-processing project, which has been successful. Such collaborative efforts can have a tremendous impact.

MR. MOELLER: That, incidentally, was one of our objectives. We were hoping that the linked institutes would want the future to involve a cooperative or collaborative move.

DR. SMITH: I do not believe that we have any negative opinions on our linkage. Regarding the question of encouraging us to contact other institutions, DRI has had the philosophy of setting up regional cooperation in which developing countries can help each other, especially the ASEAN countries. We have not encountered any problem with unrealized expectations, because we would consult each other first on each project. The only difficulty has been in implementing good ideas. For example, we would like to use cost accounting, but our system is not quite ready to employ such technology.

DR. AYALA: We have not experienced any negative points, but have only faced the usual difficulties in starting new operations. We have needed to learn more about the conditions of the country and about our own institution as well as about DRI. This has been an introduction process.

Regarding the question of the stronger institution dominating the weaker, this is a good point. In the United States there are large institutions that employ hundreds of people. Then there are medium-sized research institutes with three or four hundred people; still others are smaller. Linkage activities are perhaps more effective if research institutes of developing countries work more with the medium-sized institutions.

We had some common difficulties at the beginning in the area of information. It was more of a communication problem--requests for information would not be clear, so the information received was not what was needed. For example, our technical people asked a question about coal briquetting, and the information received was about the use of a charcoal technology. But we need technology for bituminous coal. Therefore, an accurate definition of a question or problem is very important.

Red tape between different governments was not a particular problem in this linkage. I think that we have had such problems more with other institutions than with DRI and AID. Language is sometimes a problem,

especially with the youngest people in our institute. Sometimes we need to know English, at least for reading. DRI tried to make this as small a barricade as possible, but naturally, if we all spoke the same language, communication would improve.

MS. ACHMAD: I hope that this will encourage the young staff of DRI to speak Indonesian, Thai, or other relevant languages.

DR. AYALA: I would like to mention one other point--the difference in technological sophistication between the United States and other countries. We need to determine how we can use the knowledge of more advanced countries. For example, some specialists in sugar processing worked with our young engineers and injected more advanced knowledge into our traditional operations. We also want to be prepared and informed about recent developments in coal technology. It would be beneficial, too, I think, to develop more active cooperation with the program in Pakistan in order to understand the country and its industries.

CHAIRMAN BLACKLEDGE: I really think that the experiment was too short. It takes a long time to establish a working relationship between people of the same culture, and it takes an even longer time to establish these relationships between different cultures. And when you have thousands of miles, at least in the case of Pakistan and Thailand, separating the organizations, your problems of working together and communicating are even more compounded.

Looking back on the six and one-half years of our experiment, I cannot help but feel that we really have only just begun--we have only started to define the problems. I think we have failed, quite frankly, in several areas. But this has been a process of learning, a process of evolution amongst all of us partners in this process of linkages. I hope that some mechanism can be found to continue these kinds of linkages; whether it is with IIT and DRI is not as important as whether it is IIT and somebody. In other words, I think that the linkage concept is valid. But I also think that it takes a long time to develop the confidence in both directions, to understand the problems on both sides of the linkage, and to be able to work together to solve those problems over great distances.

Hopefully, some mechanism will be developed to continue supporting these linkages. I do not think DRI fully appreciates how much has been contributed by the government of Pakistan, by IIT, and by TISTR/ASRCT. We have the records of what we spent because we are required to do this for AID. But I would guess that if we began to match dollars we would say, "We spent \$2.5 million of AID's money on this project." I would expect that we spent almost the same amount in terms of counterpart contributions, that we really have not taken into consideration in this whole process.

This is an important point that cannot be overlooked--that measurable contributions have been made in terms of counterpart funds, local support, and of everything that contributes to making these linkages two-way propositions and not just donor/receiver situations.

[This concludes the discussion accompanying Dr. Ayala's presentation of the role of IIT in development.]

STAFF DEVELOPMENT

James W.D. Frasc 
28 November 1979

Dr. Jaime Ayala, Chairman

The overall objective of the experimental program has been to improve the organization, management, marketing and technical skills of applied research institutes in developing countries in an attempt to increase their participation in national development. One of the activities involved in meeting this objective was staff development. This activity was designed to contribute to the general effectiveness and efficiency of staff performance at all levels of the organizations with which DRI worked. Several different approaches were taken: (1) in-country training courses, workshops, and seminars; (2) training courses at DRI and the University of Denver; and (3) on-the-job training and orientation projects at U.S. government, R&D, industrial, and third-country sites both in Europe and in Asia.

A number of consultation and advisory services were also provided in Denver and at the linked institutes. This activity involved the top management of the various ARIs as well as middle and lower management.

In-country training programs for workshops were conducted in the three countries of the linked institutes and elsewhere in a broad spectrum of topic areas ranging from management concerns such as institute and project management and marketing and evaluation to technical interests in the fields of chemistry, electronics, applied mechanics, metallurgy, food processing, and quality control. These workshops included over six hundred participants from the ARIs and their sponsors and clients. While not all of these activities were directly funded by the AID/OST programs, they all owe at least indirect support to the AID program with DRI. Linkages and spinoffs have occurred as a result of the OST contract, and these greatly influenced our program activities elsewhere and, in fact, provided support for these activities. This is of considerable importance in terms of evaluating the effectiveness of such a program and its ability to provide such spinoffs to other activities. For example, in many instances a management-oriented workshop may point the way toward a technical workshop.

Methodologies of approach and the mode of presentation in the workshop varied but were generally designed as a function of several variables, namely, the topic that was being presented, the background of the participants, the location, and the duration of the course. The emphasis, however, was on participative approaches like case studies and exercises that provided for maximum individual and team participation. This assured that all participants paid active attention to the presentation, and, more important, had the opportunity to share individual knowledge with the whole group. Every effort was made to see that the knowledge of the participants was shared among the group.

The workshop exercises consisted of activities such as: (1) management games, particularly the IBM and Burroughs enterprise management games; (2) in-basket exercises; (3) budgeting and costing exercises; and (4) proposal preparation, either by individuals or groups. Finally, these various exercises were followed by discussion groups.

Participative methods were affected by the background of the group and the topic of the workshop. Even the most participative training sessions included lecture materials in a classic classroom sense, not only as a background for those who may be new to the field, but as a refresher to the more experienced members of the group.

Various locations were used for the workshops: the ARIs, government installations within the countries, or resorts and other facilities far from the offices of the participants. The workshops varied in duration from four days to three weeks.

Factors that influence the effectiveness and efficiency of a workshop in a second country include:

- setting objectives and identifying topics to be presented;
- the actual selection of the participants;
- selection of workshop trainers (because DRI used not only DRI staff but consultants, ARI staff members, and people from other sources);
- language competence and language of presentation, both from the point of view of the participants and the trainers;
- determination of the group's background and the mode of presentation;
- the actual location of the workshop;
- the evaluation of effectiveness in terms of meeting or failing to meet objectives;
- social, cultural, and political barriers; and
- general communication problems.

Each of these can be addressed at any one of several levels. The location of the workshop, for example, can be a problem in terms of availability and adequacy of facilities and of convenience for participants, and of communications and any number of other factors.

The second component of the staff development program was "in-residence" training programs at DRI. This activity provided an opportunity for top management to work with DRI's specialists and gain an orientation to various areas of interest, either in management or technical areas. It also provided an opportunity for mid-level ARI management to indulge in work-study programs at the University of Denver and at DRI. This was unique to the program.

In the first--work and consultation programs--several top ARI management personnel visited DRI to discuss, re-evaluate, and redirect future ARI programs as well as existing joint ARI-DRI programs within the linkage, and to determine new initiatives that might be taken either jointly or individually by the ARI.

The second category--work-study--provided an opportunity for lower and middle management personnel to pursue matriculating programs in the university, M.B.A. or M.A. programs in business or technology and modernization. While pursuing these degrees, participants had graduate research assistantships (GRAs) at DRI. Therefore, they were in the classroom 50 percent of the time and worked for DRI 50 percent of the time. This allowed for a combination of the best aspects of training and education, the theoretical and the applied at the same time, and created an opportunity to work with DRI management at all levels, not only at institutional and project levels, but in some instances even in research laboratories.

Quite a few problems arose within this particular component of staff development and in-residence training programs, and these issues can be addressed at different levels.

- Identification of goals and objectives of the program. Sometimes too much is attempted in too short a time.
- Selection of participants can be a problem for various reasons.

The technology and modernization program within the Graduate School of International Studies specifically focuses on developing country problems, and this can be combined with the GRA program to provide a basis for the development of a new program or the expansion of this particular program within DRI. The in-residence training programs were combined with staff training at other institutions, and this activity included sending or accompanying ARI staff to other research organizations in the United States, Europe, and Asia. It also involved sending these individuals to private companies and other government installations like the National Bureau of Standards, the Environmental Protection Agency, and others.

These particular elements of the program were not necessarily oriented toward building a capacity for any specific project within the ARI, but were aimed at expanding or accenting and then refining an existing capability. It was an attempt to reinforce an existing competency rather than create a new one.

ARI staff visited numerous U.S. and third-country R&D organizations for comparative analysis of organization and management philosophy, as in the case of Dr. Ghani's trip to Europe. Dr. Shah, also from the PCSIR, visited several companies on his visit to the United States in 1978.

Visits were also made to government regulatory agencies like the Environmental Protection Agency (EPA), as in the case of staff members from Dr. Ayala's group, who gained a good orientation to pollution monitoring and control systems and problems at Galveston Bay, the EPA, and other locations. Other visits were made to U.S. and international conferences, as in the case of Dr. Cardeñosa, also from IIT, who attended the Solar Energy Conference in Puerto Rico last year.

The work-study and in-residence training programs posed a few problems. Sometimes too much was attempted in too short a time; also, selection of participants was difficult. Other problems arose with staff training in other institutions. Several variables were involved, either controllable or uncontrollable. Basically, however, in terms of the linked institutes and the people that they sent to U.S., European, or other organizations around the world, there were different sources of funding, different political and economic constraints, different management orientations, and other constraints that influenced the effectiveness of this kind of interchange. In some cases they could be overcome, but in others it was difficult.

Legal considerations and priorities were different, for example, between the countries involved. This can be illustrated in the area of environmental control, where the priorities are probably converging rather than growing farther apart. Also, the nature of proprietary technology in many industries, specifically pharmaceuticals, the metals industries, and others where private companies are not that anxious to share their highest technology, surely limits the potential of such a program. This happened specifically with Dr. Shah when he visited the aluminum companies, and it probably happened with IIT vis-à-vis people in the pharmaceutical industry.

The program was experimental, and as problems arose or as solutions were found to these problems, an attempt was made to disseminate them through various mechanisms. A handbook on workshops for applied research institutes is one of the means of dissemination.

Benefits from such a program are difficult to identify, especially immediately. However, immediate mutual benefit can be derived by the ARIs and DRI through joint proposal preparation, an activity that was educational and financially profitable for all parties involved. Proposal preparation frequently overlapped with technical assistance activities and was instrumental in introducing the ARI not only to local funding organizations but to international development support groups that otherwise may have been difficult to approach. Proposal preparation also served as a vehicle for management technology transfer. It required a group effort, often a multi-disciplinary effort, and the concepts in themselves might have been difficult to convey in a workshop session. A joint effort provided real feedback through international competition.

Indirect benefits and spinoffs from such a program are also difficult to determine. It is easy to apply qualitative judgments to reports, proposals and other documents where you can see actual improvement. But other considerations, like the contract support level to an institute, staff turnover, or the ratio of proposals written to those accepted, are not valid measures of effectiveness of a program of this nature. Too many variables are involved that also influence these processes, so it cannot be stated definitively that the program was or was not effective based on such measures.

Short-term objectives, either in terms of introducing new skills or further developing old ones or imparting information or knowledge of

various types, lead in the long run to an effort to actually change behavior in terms of management and various skills. In view of this, recommendations that are important for such a program to increase its effectiveness and become more efficient include the following:

- More and greater in-depth downstream evaluation on site;
- More programs should combine academic study and graduate research assistantships. This is an efficient way to combine the best of application and theory in both education and training; and
- More network activity. As an example, DRI sent TISTR staff to the Korea Institute of Science and Technology (KIST), where they received training in the preparation of feasibility studies. A product of this particular activity was a feasibility study in the production of high fructose syrup from cassava. A company in Korea, Lucky Limited, had a method of producing high fructose syrup from starch by using an immobilized enzyme technology and was interested in finding a country that had excess starch. In Korea, starch must be imported. Thailand, of course, has a great supply of cassava, which is primarily starch. Lucky Limited was interested in taking an equity position in a company and transferring this technology. Therefore, the feasibility study was with respect to transferring the technology for converting starch to high fructose syrup. This particular study was the direct product of a network activity that came as a result of the DRI-TISTR linkage, and it brought in a third party. DRI also has proposed an ASEAN network of ARIs, which may contribute significantly to staff development.

A number of other details could be listed here in terms of recommendations, mostly involving more effective communication channels between DRI, the ARI, the sponsor, and consultants. However, the above mentioned are the most important.

DISCUSSION

MR. KITCHELL: At UNIDO, many in-plant training and joint group training programs take place on the site of the donor rather than in-country, although we have those types of programs, too. We are trying to develop an evaluation methodology. Most recently, the Finnish authorities, who have been sponsoring a seminar on furniture-making jointer industries for the last eight years, have asked, in response to UNIDO's request that they put the program on a continuing basis, for an evaluation of the impact of these programs. But they do not know what is involved in such an evaluation.

This has been bubbling for the last two years, and I knew that it was coming. I wrote to AID to see what I could find on evaluation of training programs, and the only useful information was in DRI's Workshop Handbook, which set me on the trail of ILO and back to a fellow in England who had done some classification on the levels of evaluation.

Pending approval from the Finnish authorities, we are going to do an evaluation of their program at all four levels--not so much at the active level but at the learning, job behavioral, and functional levels.

I am not at all sanguine that we are going to discover something great and new, because the variables are too great. Both donor and executing organizations are faced with this problem, and hopefully we will determine a system that under the proper cost effectiveness circumstances may be worthwhile. I will keep you advised, and I hope that in this planning phase, you will communicate any of your ideas regarding effectiveness.

My other comment concerns staff development, which is so crucial to the success and effectiveness of IRSIs that I would like to broaden the topic. A very important component is that these institutions do their own staff development, which means that foreign experts, as part of a bilateral or multilateral project to a country, train the indigenous staff, set up experiments that teach R&D methodology, and provide consultation, not with the purpose of solving problems in a particular factory or industry, but with the purpose of defining the counterpart or the indigenous staff member who can then identify and analyze the problems. Other techniques, such as staff exchange between institutions at reasonably the same level of development, may also be effective.

We found in our evaluation that a terrible dearth of planning and carrying out of staff development programs existed in these institutions. Without such activities, they cannot operate efficiently under any circumstances.

MR. MOELLER: We should be aware not only of the internal staff development of these institutes, but of the fact that as they become effective in this area, they will also become more effective in staff development for their clients. This is a very salable product.

Of course, this could be a distraction to a research institute in that management development becomes important when it is not really the main focus of attention. Nevertheless, it can be a real way of getting into services to industry.

A number of U.S. corporations have formalized material for staff development and have agreed to make it available for use in a foreign assistance program in the United States, sometimes with qualifications. Could DRI become an agent of transmission for these materials? For example, General Electric has a highly structured, very formal, very specific management staff development program; it may be willing to make the material available but not make a blanket commitment to making the people available. DRI could supply the people to use the material and to move it into the developing countries.

MR. FRASCHE: Within the last couple of weeks, we received visitors from ICAITI in Guatemala and CIEPE in Venezuela who expressed an interest in exactly what you are describing. We sometimes disrespectfully call these "canned management" programs, but we indicated a willingness to provide such programs. Their intention is clearly to use the programs

both in-house and for various clients. So it certainly could become a larger part of the program. Elements of these formalized programs were incorporated into our staff and management development activities in the past.

I would like to add, however, that staff development and management development (and we differentiate these two activities because of the definitions in our contract) are not only crucial, but monumental tasks.

We have had training of trainers workshops and case study methodology workshops, and we have written a handbook, which is directly oriented toward developing an indigenous cadre of management trainers. The techniques that we think are most effective can be developed in-house, can be developed jointly with our linked ARIs or can be from the American Management Association or private corporations.

DR. BLACK: I would like to clarify a definition. There was an R&D management experimental element in our overall program that we have separated out in this conference as a session unto itself. We did provide management development training to our linked institutes, and it was part of staff development. Our staff training program was aimed at linked institutes through management development plus technical development of many kinds. It is not that we are excluding management development from staff development, but it is just that the management development workshops that were a part of our staff development activity were not thought of as a part of the experimental R&D management program element.

MR. MOELLER: I know of a relatively small U.S. corporation that regularly brings key people back to the United States, most of whom are from developing countries and are interested in this particular business, and gives them management training here. The training is in two categories. One is a very general type of management training--how to run a business and an industry at the same time--and a type that is more specific to a particular product line.

Would they be willing to accept a few people from the developing countries who would not be related to this specific business? The answer is, "Yes, if you pay their support, we will provide the classroom, the instruction, and everything else." They are willing, but they are not going to take the initiative. It is available, and it is a huge resource if we can figure out how to tap it. UNIDO has been tapping some of this, so I understand from a connection I have in New York. But it is such a deep well that it deserves further investigation.

MR. KITCHELL: I am a little suspicious of this. The training in the United States, unless it is very specific, leaves me somewhat chilly. I think that our emphasis ought to be more on training in the home country or on finding situations similar to those in the developing countries--situations in which the problems are similar. U.S. corporations cannot understand the problems of developing countries unless they concern a particular technology transfer as a part of a commercial enterprise, or some similar situation.

MR. MOELLER: Let me drop the other shoe because the same company said, "And we would like to have our people who are already over there engage them on the scene and follow up in adaptation of what they learned, or even prepare them for coming over." So, in fact, this is recognized. They realize the shortcomings of training in the United States, that an on-the-scene business is needed. They would even be willing to do that on-site, using their present facilities. But we are not going to make a contribution except an in-kind contribution.

MR. FRASCHE: This can be reflected in our concern over selection of trainers in these types of programs, and likewise in selection of appropriate materials to be delivered. The need for a selection and evaluation agent to see which materials and people are appropriate is apparent. Again, communication issues arise.

Another point that I would like to make concerns the directory of training opportunities in the United States. The last edition was published in 1975, which means that the data are from 1974 at the latest. We would like to propose an update to this document that would include not only opportunities of the type that you are mentioning but topic areas like energy management and others that are not now included. This could definitely be a vehicle, given appropriate selection and evaluation of such a directory, to make such information known and available to those who desire it.

We also recently acquired the International Management Development Institute, which was housed at Business International Corporation in New York. We have recently been talking with Business International about getting together with some of their member companies to provide exactly this kind of training. The topic of "Cash Flow Management in African Countries" was the first specific proposal.

MR. SEWELL: Have you ever been called on to advise on the criteria of the initial selection of people--of staff members of a research institute? In other words, would an organization ever ask you, "We want to accomplish X. What kind of people should we have?"

MR. FRASCHE: Yes, I think so, but it would be an exception rather than the rule. It is difficult to select individuals.

MR. SEWELL: I am not thinking of specific individuals, but of necessary qualifications.

MR. FRASCHE: We have, I think, pretty strong communication in the early planning stages to determine what level of the organization should be addressed with specific objectives.

MR. SEWELL: Would Dr. Ghani, for example, have reasonable freedom in selecting the staff members?

DR. GHANI: Yes. In Pakistan more emphasis should be given to staff development in R&D. The general concept in the developing country is that anybody who has a Ph.D. has become the topmost scientist and can solve any problem at any time. When these people work in the United

States, they become very productive, but in their own country they are not because conditions are different, especially in regard to technology.

As Jim asked me yesterday, "Why electronics?" Because we face very basic problems in this area. If electrical equipment in our laboratory breaks down, no one can repair it. So we need somebody who can maintain our equipment and therefore need a section on electronics. The center has been generally out of touch with the subject. Solving problems in the United States or in Europe does not help our staff because when they return to their own country, the problems are of a completely different nature.

The only solution is for people from here to go to the developing countries, give lectures, explain the latest developments, and try to help with problems.

MS. LUCAS: Are you referring to two different types of people? When you talk about allowing people to do research in order to have a repair and maintenance facility, it sounds as if you are not really talking about people with Ph.D.s. If you are, why have a Ph.D. for repair and maintenance?

MR. SEWELL: That was the point I was trying to raise earlier.

MR. KITCHELL: This is what is lacking in most of these institutions--a plan to develop services over a given period of time--a plan that after, say, five years begins to utilize a different level of services requiring a different skill mix. To begin with a Ph.D. doing repair and maintenance causes frustration on both ends.

DR. GHANI: The simple answer to your question is, if a man is not a Ph.D., his pay scale is dropped. You must be a Ph.D. to go up. Whether you do good work or not does not matter.

MR. FRASCHE: Also, when the Ph.D. returns to the institute, he can fit into only a limited number of positions. Therefore, he becomes a Ph.D. maintenance engineer. It reflects a broad and pervasive shortage of positions to be filled.

MS. LUCAS: We perpetuate the same situation in this country when we require that a store clerk at Penney's have a B.A. This is because we have such an overabundance of educated people. But it seems to me that when you continue to hire Ph.D.s or B.A.s or M.A.s for technical jobs that perhaps could be filled by people with two years of vocational education, it is perpetuating a situation which at some point needs to be undercut.

DR. GHANI: That statement is not really relevant. Generally, those who have Ph.D.s are actually doing research work, not maintenance and repair.

MR. FRASCHE: We determined from our evaluation of the program earlier this year that most of the people in the laboratories with whom I spoke

in all three institutions expressed a need for staff development in vocational education rather than in academics. But so many factors need to be identified such as the language capabilities of the people to be trained, who will train them, and after they have been trained, what is the likelihood that they will return to their institution? Is it, in effect, worth training and investing money in such a program?

However, at least one institute department has a director who would prefer to hire people for his department at the International Rice Research Institute who have done very poorly in academic training and have more practical hands-on training. He can actually maintain the credibility of the organization without having to say, "Yes, we have eighteen Ph.D.s and twenty M.S.s." He can still get sponsors and do good work without having to perpetuate a system that is self-defeating.

MR. KITCHELL: On this very significant question of staff development, the most important point has nothing to do with training. It instead goes right back to the essential question of the role of the institute and its plan for internal growth. The very selection of the function or activity to be carried out by the institutions--beginning, for example, with supporting services like quality control and surveying industry in terms of indigenous resources--is the most important part of staff development. This needs to be followed up by extension services in which you begin to get out of the institute and into the milieu with which you are supposed to work. This is equally important but probably is not recognized or given enough attention by the sponsors and managers of IRSIs.

CHAIRMAN AYALA: I agree with you that these aspects of staff development are very important for our institute, and I would like to add a comment about evaluation. Sometimes when you ask for evaluation, you cannot evaluate only one component of the activities. It is difficult to have specific evaluations of some components, such as attendance at a workshop. Evaluation needs to be considered in terms of an entire program.

[This ends the discussion accompanying the presentation on Staff Development.]

INFORMATION SYSTEMS

Suellen White
28 November 1979

Sjamsiah Achmad, Chairman

The information systems program began as an input to the technical assistance activities. It is now a spinoff because it began with a narrow focus and broadened.

The overall objective of the Know-how Information Service--called KIS--was to assist selected information personnel in linked ARI technical information centers in improving their management and technical skills for the delivery of technical information in support of research activities. Therefore, it was closely linked to research goals. The secondary objective was to disseminate the KIS information on a worldwide basis.

To accomplish these two objectives, several goals were established:

- to increase the awareness of technical information systems as an integral part of the research process;
- to increase the ability of the linked ARI information personnel in anticipating and answering information needs of their users;
- to create an awareness of worldwide resources, resource-gathering techniques, and various methodologies available for information programs and projects;
- to disseminate, based on experience with this program, a handbook for accessing scientific and technological information; and
- to establish a foundation for the growth of information services within linked ARIs.

The program was organized under six activities: (1) supplying technical information for research, which was the main thrust of KIS; (2) industrial information seminars; (3) conference information dissemination program; (4) lateral technology transfer program; (5) selective dissemination of information; and (6) individual training elements. The supply activities were to support individual linked ARI programs and to provide a model for future S&T information acquisition.

Know-how information consisted of wide-ranging types of information--the state of the art for appropriate processes, industrial manufacturing information, patents, and product manufacturers. It was also an identification of technical and market survey information for preliminary market analysis.

The other five activities were in support of network development activities based on the same premise that upholds technical cooperation among developing countries--the TCDC concept. This concept includes programs to establish and strengthen the organizational infrastructure and substantive capabilities of developing countries for promoting

mutual cooperation. The concept also includes a provision for the utilization of know-how and expertise, consultancy services, training facilities, equipment, supplies, and so on by the developing countries. The overall goal of network development activities was to create a resource-sharing program among ARIs that would foster local technology transfer flows. Other goals included the provision of a model for alternative methods to S&T information acquisition, encouragement of cooperative resource sharing, and the creation of awareness of the benefits of low-cost acquisition projects.

There were six network development activities, including a newsletter exchange program, a conference information dissemination program, selective dissemination of information, lateral technology transfer, the development of a directory of company industrial contacts, and a technological opportunities file.

Several accomplishments from this program have been identified.

- Training programs designed to facilitate the access to and utilization of S&T information;
- Network models for cooperative lateral information transfer among the developing countries;
- The creation of a five-year management plan for the Thai National Documentation Center, which requested that DRI develop this plan;
- The transfer of valuable technical assistance information. The results varied depending on the purpose of the information; for example, whether the information was needed for preliminary market studies or for comparison of available machinery, and so on;
- Increased communication between information specialists and technical researchers. The technical staff became more aware of the importance of information and how it benefits their work, thus communicating better with information specialists. Hence, the overall quality of information improved, and an emphasis was placed on the framing of reference questions. Also information specialists began to view their service in an active, rather than a passive, mode.

The beneficiaries of the information activities were information personnel, technical staff and researchers, industrial clients, and the information community that benefited from the broad scope of the workshops. Approximately sixty persons participated in the two industrial information workshops. One was held in Thailand, the other in Colombia. It is difficult to estimate the number of people who benefited as secondary recipients to this training.

Several problems arose during the course of the project, and they fell into four general areas: communications, management, the nature of S&T information service, and developing country attitudes. Although the exact manifestation and intensity varied between the individual institutions, the issues still applied to the three linked institutes to some degree.

The greatest difficulty in communications arose from the lack of opportunity for sufficient and timely interaction between DRI and the ARI when the latter had an information request. It was also difficult for DRI to clarify what information was actually needed. On the other end of the communication process, when ARI personnel were asked to evaluate the information that was supplied, DRI often did not receive sufficient feedback. Thus, it was also difficult to obtain constructive criticism.

The management problem centered around organizational relationships within the ARIs. Information personnel working directly with the users often had to communicate indirectly with DRI through hierarchical channels in their organization. This definitely was a barrier.

The need for better understanding of the nature of S&T information service became apparent in a variety of instances. For one, the developing countries often did not fully understand the information search--they believed that the results would be a perfect solution to their problem. In reality, appropriate technology information often does not exist in a technical article or manufacturer's catalog, for example. It was also difficult to explain the cost of information. Information is not free.

Attitudes of developing countries required careful consideration by DRI staff as they sought to implement the information activities under the AID project directive. The institutions were product-oriented, which influenced their receptivity to various aspects of the pilot project. Over the long term, they tended to be more interested in the actual supply of information than in DRI training efforts.

Considerable confusion also occurred over the role of information personnel within the ARIs. Some believed that these staff members needed to be no more than documentalists performing clearinghouse-type activities, while others thought that a technical person was adequate to provide information without any specialized information training. Others tended to exclude information personnel from the mainstream of the institute. These attitudes served as barriers to the type of information service that DRI perceived to be truly effective in a development context--that is, an information service that can operate as an integral part of the development process. It should be neither underutilized nor overindependent of technical expertise and must be responsive to the needs of the ARI research staff and the industrial community in the developing country.

DRI consequently learned some lessons that directly correspond to the issue areas and attempted to cope with the problems in various ways. To combat the difficulties with the slow transit of information, DRI concentrated on speeding up response turnaround time. Alternative communication methods and implementation of innovative approaches to cutting down request response preparation time are being explored. To compensate for the lack of person-to-person interaction, it was necessary to develop information request forms that prompted ARI personnel to provide sufficient background information in stating their

needs. It was also necessary to develop an evaluation form that solicited developing country opinion in as neutral a fashion as possible. Yet this was not always adequate for assessing the evaluative material. DRI is now exploring alternative methods of evaluation that focus on actual impacts.

The management problems inherent in the ARI organizational structures were more difficult to solve. DRI realized the importance of identifying internal barriers to information flows at the beginning of the information work and of taking a team approach that involves ARI administration, researchers, and information personnel. The key to successful information transfer was to have personal contact between DRI and ARI information personnel. Time, DRI's willingness to listen, patience, and persistence all played major roles in building confidence in our suggestions. Most of the positive results came from the continuity fostered by one DRI staff member managing all the activities within a given ARI project.

Information workshops were conceived in order to help researchers and information specialists gain a wider perception of the nature of S&T information service and to discuss how pertinent attitudes affected that service. While conducting these workshops, DRI found it essential to balance theoretical lectures with participant discussions regarding how theory actually applied to their situation. This reflected the desire to have concrete, problem-solving information rather than theory.

DRI also found that the workshops were valuable vehicles for developing communication channels between the ARIs and external groups such as national policymakers and the rest of the national development community. The desired result was to arrive at a widely held, more integrated concept of how information services could support development efforts and a broader appreciation of their value in a development context.

Suggestions for the future include:

- Create an environment wherein the value of information is understood;
- Design evaluative criteria to measure the impact of information;
- Design user surveys that evaluate existing information needs according to sectors. These should be completed to lay the groundwork for effective information services;
- Develop information programs that emphasize education and training and the creation of infrastructures that can accept the increased information flows; and
- Encourage the use of U.S. resources by making them more available and easier to access and by ensuring an awareness of that availability. Possibilities include more unified access to governmental resources of information and more awareness of what the private sector can offer.

DISCUSSION

MS. ADLER: I think that the most important assistance we offered was in helping the linked institutes to understand the importance of S&T information in the broad perspective of development and how information was integral to all development activity. It was very much a key to communication between researchers, information specialists, and development planners.

MS. BLUM: On our part, we learned that we cannot exist without a technical assistance effort as well. Technical information plays an important role in development, but it must go hand-in-hand with the technician who can interpret it. When you merely pass a technical article between boundaries, the chances are, especially if your client is in industry, that he does not have the time or the equipment to adapt the information or may not have the necessary education. We want to make our case to the technical people that information can play an important role in goal achievement, but we also feel that information people must realize that technical assistance is essential to the information transfer.

MS. ADLER: Two activities were extremely important. One was helping to define the reference question. We helped to set up communication channels between information specialists and technical researchers so that they understood the parameters of the universe of information. In that way, they could better communicate with each other on the exact type of information that was needed.

Once the idea of the importance of defining this reference question became well known among the researchers, they, in turn, started to do more of the research themselves.

An important part of this project was not just answering KIS information requests, but implementing a training program as part of the request answers. Every time we answered a question, we explained the process so that the steps involved in answering information questions were recognized. Training was built into the information transfer, and by the end of the program, questions were being phrased much more succinctly. More specific types of information were being requested.

Another important element of the program was introducing the linked researchers to the usage of formal and informal information sources--the formal sources being the library tools or the NTIS on-line data base. Also, using the same tools to locate informal sources, such as using a research directory and discovering that thirty people in the United States are interested in rice processing, was another technique. This was like starting an invisible college in which the name of one expert led to another. By the time the search was conducted, you had a good idea of who the experts were and how you fit into that spectrum of knowledge.

MS. FLYNN: When the ARIs have need for technical information, do they first turn to DRI to help locate that information, or do they go more directly to the sources?

DR. AYALA: I would like to comment on that and on other points that we are discussing. Of course, information is a very important resource, and all of us recognize its value. The cost of information, however, must be considered, especially if we are trying to find specialized information. For example, abstracts are costly, and if you need specialized information, such as a handbook on chemical economics produced by the Stanford Research Institute, or feasibility studies for plants, the cost is very high. We do not use this type of information every day, but sometimes it is necessary to complete a specific study.

The other problem is access to some sources of information. Of course, when you can locate people who are working in the same area of research, you can establish direct communication. So the role of the information system is mainly to locate the right sources, the right person, the right institution. After that, the people will continue to exchange information.

Sometimes, however, we need help in accessing your data or that of specialized information organizations; for example, EPA information. Direct communication between my institute and the EPA is difficult--it is especially difficult to locate the right information. Therefore, I think that in the future we will need assistance in the areas of cost of information and access to specialized information, especially to some technological data banks.

I would like to comment about the problem of defining specific needs. For example, in the case of my institute, we started with a very small group for our information service that was considered a service mainly to small- and medium-scale industries. Now we are trying to use these information services for internal purposes. Our institute, however, has varying information needs. Researchers may require certain types of information, while we need product-oriented information for our technical and economic studies. We need to know all that we can about different technologies and processes.

A final comment about the cost of information--we recognize the value of information, but sometimes we do not recognize the cost of information. This is why we may need to establish the capability within our institute.

MS. LUCAS: What is the most typical means of sending information to a client or group of clients--computer terminals, letters, or telephone calls? Also, what is the most frequent source of information? For example, is it the EPA, or a researcher in the university?

MS. WHITE: In answer to your first question, the mechanics varied. The most commonly used vehicle was a letter. The best way was to have the letter hand delivered by a staff member who had been at the research institute. This way we could get more background to the information.

Information also arrived by Telex and telephone. Often, these vehicles were inadequate, because one of the key elements to refining the question is verbal interaction, and that, unfortunately, was not possible most of the time. Also, many of our questions arrived through people's trip reports and other similar communication channels.

The second question is more difficult to answer. I would say that approximately eighty different questions were answered under the KIS supply element, and the majority of the answers were derived from a combination of sources, one of which was technical expertise. Many questions centered around agricultural products or methods, and technical experts and their various laboratories were great sources of information. They would identify manufacturers with whom they had worked in specific areas, such as rice hulling or cashew nut farming. They also identified unpublished technical reports as well as consultants.

Another source of valuable information was private manufacturers. People who actually produced the equipment were also very familiar with the problems surrounding it. Patents were another good source of information. As a matter of fact, PCSIR took the best aspects of thirteen patents for fruit driers and used them as a basis for developing a new type of drier.

MR. MOELLER: I would like to note that, for the most part, the patents were expired and therefore in the public domain. I have no prejudice against unexpired patents, but I think that the objective here was to mine a publicly available resource. I am curious to see what the return is.

MR. FRASCHE: I would like to add that staff development activities, especially visits of the ARI personnel to the states and to various governmental organizations and universities, provided a basis not only for immediate information gathering but for creating the kinds of relationships that make information requests from individual to individual through letters considerably more feasible. I am specifically referring to the case of IIT in terms of pollution control. I know that their scientists communicated regularly with EPA officials whom they met in the United States, and this eliminated an intermediary. This is definitely a valuable function of staff development programs.

MR. MOELLER: As we listen to a description of the whole project in which DRI was engaged, we could classify about 95 percent of it in information transfer. Much of the technical assistance occurred by having somebody transfer information on the spot. We must differentiate between information transferred as a support function and information transferred as an operational function. If we do not make this distinction, we fall into one of two possible traps. We will either categorize everything into or out of informational services.

Contacting an individual who is active in a particular field can result in all sorts of references, such as a possible consultant. This is what I would call support information services. The next step, moving to consultants, involves direct interaction and becomes a consulting role rather than an information service function.

MS. BLUM: This brings up a major point--that information is integral to a technical assistance effort. Our difficulty in asking where one part stops and another begins shows that the connection is inevitable.

On the other side of the coin, some people think of an information unit as a library. But we want information to be more active. We want it to flow into the technical assistance continuum.

MR. MOELLER: I think that the function of the intermediary is critical in technical assistance.

MS. ADLER: This is an interesting point. We talk about utilizing informal sources to a greater degree, yet an obvious problem is that Thailand is on the other side of the globe. Communication is difficult and takes time. This is a critical issue and one that we will have to address if we intend to increase the value of U.S. information. Dr. Ayala had difficulty in reaching the EPA. It would be advantageous if research institutes in the United States could create an information clearinghouse that would facilitate access to the right individuals for developing countries, researchers, or institutions. It seems that a system could be developed that could get information to the right places at the right times.

DR. AYALA: I would add that we need help when a solely mechanical system provides information. NTIS may provide reports, or I may receive a document with hundreds of references, which I then need to review and analyze. With all of these processes, communication between countries is very difficult.

One of the greatest problems regarding information in my institute is that we are continually receiving different initiatives about networks and worldwide information systems. Every United Nations special organization has its own network or universal system. This is difficult to understand, and it is also difficult to attend to their requests.

MS. WHITE: What are the incentives for participating in a network, so that ARIs would be encouraged to join?

CHAIRMAN ACHMAD: This is precisely the point I was going to raise, because I know that DRI is trying to help the institutes gain access to available information. However, does DRI pay enough attention to all of the complications surrounding the ARIs? I therefore suggest that, in this project, the institutes need help in identifying their functions. Are their first responsibilities to serve industry, to serve the scientist in the institute, or to serve other information needs? From this, you proceed to help the information personnel as well as the information users. This is usually neglected.

You have repeatedly stated that you are the link between the producer and the user of information. Usually the producers are the users--scientists produce scientific information, yet they need scientific information from other parts. And obtaining this information is the function of the information specialists or information personnel. Unless these groups understand one another's function, it is very difficult to communicate. Therefore, developing a method for expressing your needs as a user is important.

Many times the users, especially in the developing countries, do not even know what they need, or they cannot state what they need. Therefore, in addition to training information personnel, we need training for users, and this, of course, could be in the form of workshops or some other means.

The problem is having too much information--we just do not know which way to go. So if you help an institute, please do not direct them to get too much information from the United States or through DRI, but rather to get information locally, nationally, and regionally.

MS. BLUM: We did try to address this problem in the handbook, which was actually a follow-on to the AID contract. I agree with you that it is a difficult problem. In the handbook, we discussed the pros and cons and pointed out that the users' needs must be held paramount. So the program in which you choose to participate should reflect user needs' and you should decide to participate in a given international network because you believe that you must go outside of your country to meet the user needs. We also gave suggestions for identifying those needs.

I agree with you, though, that at this point the large amount of information available makes the going very confusing. That gets into another issue, which is coordination between systems.

MR. MOELLER: I would like to tell a story that reflects the problem of cost.

About one year ago, I put in a \$900 purchase order for a report. It was returned to me on a technicality and I resubmitted it. It came back again, this time saying, "The information already is in AID's possession. We have created this information." So I went to our Information Services Unit, which perused the records and stated that no such information existed. I even worked up keywords for the report, to no avail.

So I sent the purchase order forward again. Back it came, saying, "Sorry, may not be in AID, but it is somewhere out there. It is already in a report." To solve this problem I had to return to Information Service. We searched thirty-six data banks. In the end, it cost us in direct personnel and computer expenses \$4,200 to process that \$900 purchase order. If the Information Services had not been available, they might have taken my word for the need to purchase the report.

[This ends the discussion accompanying the presentation on Information Services.]

TECHNICAL ASSISTANCE

James P. Blackledge
28 November 1979
Raymond Kitchell, Chairman

Six and one-half years ago, the idea of the experimental project was to help the linked institutions in developing their technical capabilities. It was only in the second phase of the contract that the AID contract people became nervous about the fact that this was a very broad mandate with not many constraints. Therefore, they insisted that DRI categorize technical assistance activities into staff development, information services, research grants, technical assistance, and other areas.

With the passage of time, DRI has continued to provide technical assistance as a broad umbrella. However, the various areas overlap, and their definitions become confusing. For example, is assistance in writing a proposal a part of staff development, or is it technical assistance? Perhaps the project should have been defined in such a way that arbitrary distinctions between the areas of technical assistance would not have been required.

The initial approach was to meet with the linked institutions to determine their needs. The objective was to provide assistance that would help the institutes interact with some industrial component of their country. For example, people were sent to Pakistan to help conduct techno-economic studies on the production of magnesium or potassium salts from the bitterns or the residue left over from the production of table salt. DRI also provided assistance to the PCSIR in a techno-economic evaluation of fish protein concentrate. IIT wanted to become involved in the pollution problems of the Cartagena Bay, and DRI provided them with an entree into the Environmental Protection Agency. As a result, several IIT staff members ultimately received training in pollution control in the Galveston Bay area. These are examples of a combination of staff development and technical assistance.

As this type of assistance was being provided, DRI began to realize that in many cases the problems were of great technical interest to the institutions but lacked political interest. The bitterns project is a good case in point. The techno-economic study was well done. There was every justification for proceeding with it, but for a variety of reasons, some of which were political, the program never progressed beyond the techno-economic feasibility report. In contrast, the fish protein concentrate study is being pursued and will be a viable project for industrial use.

It became apparent that it was not enough to send an expert to a linked institute to help solve a problem. No matter which institute the expert came from--whether it was DRI, another U.S. institute, or an institute in a developing country--a rationale had to exist between the interest on the part of the linked institute and the end user. Political considerations and industrial need were obvious. Therefore,

DRI began to develop a thematic approach in which efforts were concentrated in one or two areas. DRI rejected the philosophy of sending an expert to work on any problem that interested a linked institute. Instead, institutes were asked to define the main problem areas in which the government was interested. IIT answered that the government of Colombia was concerned with coal processing and briquetting, production of high-protein, low-cost foods for consumption by low-income groups, and the processing of panela or crude brown sugar. The linkage agreement with TISTR was developed with the realization that integrated rural technology development was the major functional interest of that institute and the government. In the case of PCSIR, minerals processing was deemed most significant. It had both governmental support and industrial interest.

The decision to take this type of approach was arrived at jointly between the management of the linked institutes and DRI. Through dialogue, it was agreed that energies and limited resources would be focused on one or two problems rather than on every problem that presented itself.

Of course, DRI helped to develop proposals. The village-level food-processing project in Pakistan that was aimed at improving village-level production of brown sugar has already been mentioned. DRI was told that if the yield of brown sugar from cane could be increased by only 5 percent, it would have an impact of \$70 million on the economy of people in the rural areas. After conducting a worldwide literature search on sugarcane technology and talking with people in Thailand and Colombia, it was discovered that simple adjustments in the machinery would make it possible to increase the yield of juice from cane by 5 percent.

The point is, however, that this project should have started at the agricultural end, not at the technological or mechanical end. Pakistan obtains about eleven tons per acre of cane during the growing season. Hawaii gets about ninety tons. Furthermore, the cane in Pakistan is infested with cane borers. The 5 percent increase that can be achieved easily and that is being achieved could be increased even more by proper agricultural practices and better strains of cane.

But to return to the point of sharing information--this is where technical assistance becomes very important. Both IIT and PCSIR were interested in brown sugar, and an exchange of information between the two institutes was initiated. The experience that Colombia gained in producing brown sugar in small amounts was equally applicable in Pakistan, and vice versa. The same mechanism was used in packaging. The capability was developed in Brazil, outside of this contract, and TISTR and IIT became interested in the technology. DRI provided the expertise to conduct packaging seminars in Medellín in Colombia, and the packaging expert was sent to both Colombia and Thailand to assist in the development of programs and proposals that hopefully will continue in the future. Another relationship developed between IIT and KIST in the area of extruded food technology. KIST had a considerable amount of experience with the use of a modified crop cooker for extruded foods, and DRI arranged for a team from IIT to visit Korea and use their equipment to discover whether or not the KIST process was beneficial.

This kind of technical assistance should be kept in mind for the future and perhaps should have been applied more in the past. If these types of interchanges had been initiated six and one-half years ago, DRI's technical assistance activities would have been much stronger.

An example of the kind of problem that DRI has experienced in sending experts to developing countries is reflected in the electronics project in Pakistan. The PCSIR had requested assistance in the field of electronics, and DRI sent an expert who was there for almost one month. It was assumed that he would discuss the development of an electronics industry that could manufacture electronic components. The consultant returned extremely enthusiastic about the possibility of building electric garage doors or gate-openers in Pakistan, and he based this on the fact that every time he drove down the street, a car would drive up in front of a house and a man would run out and open the door. However, if automatic garage door openers were installed in every house, a tremendous unemployment situation would occur--thus defeating the purpose of the entire project. This was certainly one of DRI's failures. Both the staff of the PCSIR and DRI have laughed many times over the fact that the electronics program produced a design for a garage door opener rather than a design for a hand calculator that could be manufactured in Pakistan.

One other point is that networking is very popular. DRI tried this a number of years ago in the area of fungal fermentation of agricultural wastes. A network was established with ICAITI in Guatemala, with IIT in Bogotá, with the Federal Institute of Industrial Research in Nigeria, with ITAL in Brazil, with TISTR in Thailand, and with the PCSIR. A high-technology process had been developed by NASA that involved growing protein for astronauts in flight. It was an interesting project because it was based on using the excreta of the astronauts. Of course, this is another example of a failure--or actually a technological success that failed from a cultural point of view. The astronauts refused to eat the food. But the DRI project utilized the technology for the production of animal feeds. Since animals cannot talk back, it is not known whether or not they like the final product.

The technology could also have a tremendous advantage in cleaning up the wastes that were being dumped into rivers and streams. The idea was to create a network of all linked institutes in which each institute would utilize available wastes. TISTR would work with cassava, IIT would work with commercial fruit and vegetable wastes, and the PCSIR would work on extracting starches from the wash water produced in the textile process. It was a fascinating program, but DRI failed to get it funded. It died a natural death because none of the institutions had the money to continue. The point is, a number of experiments have been carried out, and this one had great potential but did not go as far as it should have. Perhaps it will someday be picked up and carried forward.

DISCUSSION

CHAIRMAN KITCHELL: This project was planned but never started because of a lack of funds?

MR. BLACKLEDGE: We had a \$200,000 NASA grant and worked for two years with ICAITI. We also operated a pilot plant in El Salvador in which we were able to produce some fungi that were about 45 to 55 percent protein. But we ran out of the NASA grant money. During that time, we started the network, but it came to an end. We were unable to convince the people in AID to fund the program--perhaps we did not know how to sell it. In fact, that may have been our greatest problem.

CHAIRMAN KITCHELL: Cooperative research is a popular item these days, and this might be an excellent proposal for the UNCSTD recommended interim fund on science and technology.

MR. MOELLER: I would like to continue on this subject by providing a glimmer of hope. Information is creeping out that people are moving to assess the quantity of waste materials available in the world today for this particular purpose. Waste bananas are another source since many are thrown away into local rivers. Coffee wastes are another example, and people are beginning to assess the magnitude of the resources that are available for this work. A cooperative research program may well be worthwhile, whether it is sponsored by UNIDO or some other organization.

DR. AYALA: Now that the experimental program has ended, I hope that we can all think in terms of continuing some of the projects and finding different sources of financing, particularly for developing networks between institutes and for continuing the project in fungal fermentation of agricultural wastes. We are probably now ready and have more national interest in these types of programs. For example, in the time frame of the experiment, our National Federation of Coffee Growers did not have enough interest in the problem. But now the problem is critical because we have been increasing productivity in the coffee areas and fewer workers are used. Pollution is also a bad problem. So we need to act now. I am not asking this as a specific request of the conference, but hope that you can give us some help.

MR. BLACKLEDGE: A good example is to find a mechanism to continue an interrelationship between IIT and PCSIR, both of which are concerned with the same problem--production of brown sugar at the village level. We were able to do this until now vis-à-vis the contract with the AID mission in Pakistan and the generosity of our OST monitors, who allowed us to consider this as part of our technical assistance to IIT. But that project is not concluded, and there should be some way that it can be continued.

CHAIRMAN KITCHELL: The question is raised, too, as to when technical assistance is positive and when it becomes a crutch. Judging by the sample in a recent UNIDO evaluation, most of the institutes are not very effective. Their services are limited generally to supporting services and laboratory testing, or, at the other extreme, to highly esoteric in-house projects that have no application. Many of the problems facing them are internal impediments that cannot be solved or effectively assisted by outside agents. The problems of political recognition, of paying adequate salaries, and of giving the institute autonomy are all solvable, but internal actions must take place. Many of these institutes have the base to move forward but will not do so until other

problems are solved internally. Much technical assistance has been provided on a bilateral and multilateral basis in creating these institutes. I am wondering, as a generalization, of course, if at this stage the best type of technical assistance we can provide or fund is getting institutions to work together on a specific problem or activity. If you can get four or five institutions working together on the fungal fermentation project, presumably you will not only come out with a product that is useful in all of these different countries, but every one of those institutions will have been strengthened on how to exchange information, how to provide extension services, how to look at the marketability of the products, and so forth.

MR. MOELLER: You have touched on a very sensitive point. I think that we should go back six and one-half years and realize that the whole project was based upon two simple premises. One was that the ARIs can be an effective instrument in a country's development, and the second was that they were not at that time anywhere near as effective as they should be. Therefore, can we develop methods to improve their effectiveness in this field? If we understand that, we cannot just sit back and say that they are not effective and therefore we should turn to something else.

The other point is, perhaps one of the real tools that the individual institutes need is a concrete, visible success story. If, for instance, the cooperative work between IIT and PCSIR can be shown to increase the yield of pameia by 5 percent, both can take credit for the total package in each of the countries. It may provide a leverage to correct some of the internal difficulties. It is a chicken-and-egg situation to a degree. You cannot get the success without the effectiveness of the internal solutions. On the other hand, you may not be able to get solutions without being able to demonstrate success.

So we are in this situation, and I think I detected from Dr. Ayala's comments a small degree of frustration. You have begun a project and you now see real possibilities of attaining a goal, yet the ability to attain it is slipping from your grasp. You must build again the capability and resources to continue. But at least we have moved this far.

I am optimistic about some of the results. Some of them are rather laughable. Regarding the attempt to sell the fungal fermentation project to AID, the way in which it was done made it so easy to translate into this comment--which is not quite a direct quote--"Huh? A million dollars to grow a little animal on a banana peel? No, a bug, it was a bug on a banana peel."

MR. BLACKLEDGE: A mushroom type.

MR. MOELLER: Of course, you put a million dollars against a bug on a banana peel and no one in our agency could even think about buying it. But I think the time has come to resell.

MR. BLACKLEDGE: I would like to make one more comment that relates to the current interest in TCDC. I do not work for DRI any longer, so I

say this with a clear conscience. In actuality, I think that the VLFP project in Pakistan would have been more effectively performed by a working relationship between IIT, as an example, and PCSIR, than with DRI acting as an intermediary. The technology existed in both countries, and it was really a matter of sharing that information between two institutions. We in the United States have not worked with brown sugar since the 1900's.

It seems like a good idea--IIT and PCSIR working together on improving the productivity of panels, on the one hand, and gur, on the other, with the products exactly the same, and the processes almost the same. But that was not possible under the funding arrangements. So DRI served an intermediary role, which resulted, of course, in a certain loss in the transmission of know-how and information.

I am not apologizing for the role that DRI has had in this project--I think it has been good--but it could have been better had it been a direct relationship between the two institutions with real expertise in this field. This is what I think TCDC means in the final analysis.

MR. MOELLER: In my two and one-half years with the Agency for International Development, I have come to the conclusion that the only way in which the agency will be able to work effectively in the industrial development of developing countries will be with a strong emphasis on small- and medium-scale industry. I have had a background in both small and large industry and have a reasonable feel for their relative positions in growth. I perhaps do not have as good an idea of their specific positions in developing countries, because my experience in detail is restricted principally to Brazil. However, I have arrived at certain conclusions. If we are concerned with the growth of the industrial sector, we have only two choices--creating new industries or increasing the size of existing ones. In fact, we do not have a choice--both must occur.

When I look at the developing world, I see a large number of relatively small countries in which it would be disastrous to promote large corporations. On the other hand, neither do I want to promote a proliferation of tiny industries. Therefore, I am seeking a balance to distribution.

I also find that industrial employment in countries such as the United States, Egypt, Colombia, and Brazil is at the very minimum 50 percent in small industry. In the United States, a large portion of the innovation, the productive creativity, occurs in this sector, and the dollar-for-dollar return is much higher. With this in mind, I conclude that if the major technological resources of a country are devoted to other industries and exclude small- or medium-scale industry, it would severely handicap and inhibit a large potential.

The question then arises, how can an ARI that is supported by the government assist in the establishment and growth of viable small enterprises and at the same time continue to serve the full spectrum? A substitution of resources will obviously occur, but I am not interested

in abandoning the big end for the little end. This is the problem--how can ARIs effectively function in this day? Is there a programmatic problem, an organizational problem, a philosophical problem, or a political problem? I know that it is an economic problem.

MR. SEWELL: I feel a very strong commitment in this area to small industry. This commitment has its roots partly in a philosophical sense, partly in a pragmatic sense. There are three or four areas in which small industry has been served and can be served by the research institutes. One is in technical services of rather broad application, attacking a problem that is identified as common to small industry in a given area. Then there is the industrial extension side, in which an individual attacks a problem that is unique to a particular company on-site. A third dimension is the nontechnical problem, which relates more often than not to management. The entrepreneur is often capable of working in a rather narrow technical area or performing a specific task, but managing the enterprise may be difficult for him. A fourth dimension is funding the growth of the small enterprise.

All four of these aspects are extremely important and have an impact on the use of resources. This is true from my experience in Latin America. I would like to ask Dr. Ayala if this appears to be the case in Colombia.

DR. AYALA: I would like to recall IIT's experience in small- and medium-scale industry. We started a program with the United Nations specifically to establish a program of technical assistance to small- and medium-scale industry in textiles. With this project, we had the opportunity to experiment with different ways of selling our services. We have technical services, industrial extension services, and especially services concerning problems in managerial skills and the location of financing. I agree that these are the three main elements for trying to increase the size of existing industries and to modernize them and to create new industries.

Because of the specific conditions in Colombia, we are trying to concentrate IIT's efforts in technological assistance--technology in relation to raw materials, processes, machinery and equipment, products, and the quality of the products. This is not because we do not consider that managerial and financial assistance are important.

We would like to have more coordination between the three elements. We would like to continue to assist small- and medium-scale industries as well as the larger ones. The development of Colombian coal resources is an example. Coal needs to be developed in any case, and we need to know the quality and quantity of the deposits. So we did a study that will affect small, medium, and large industries as well as the general economy of the country. The foundry industry is another example. Regardless of who benefits, we still need to make scientific studies on raw materials. All sizes of industries will benefit from these studies, but the small- and medium-scale industries will gain the most because they do not have their own laboratories for testing and trying to

improve these raw materials. Therefore, I consider that the role of an institute like IIT in serving small- and medium-sized industries is definitely an important part of our work.

Still, we must be concerned with finding the funds for our projects. We received money from the United Nations for paying experts, buying equipment, and sending some people abroad with fellowships, but for the local expenses of our personnel, we have had to use our own funds, which are low. We have also tried to obtain funding from the government because we consider that assistance to industry should be supported by the government. But our efforts are not always successful, so we needed to move more toward industry. We ask for funds not for the institute but for serving industry. I think that in any part of the developing world, this type of service must be subsidized for social, political, and economic reasons.

We have also tried industrial extension services. In this area, I believe that we can have more success in the managerial aspects, such as preparing requests and proposals to financial institutions. The most difficult part of industrial extension services is in technology, because it is a costly operation. This is why we think that other Colombian institutions may be able to provide extension services in a more efficient and economical manner. I have mentioned SENA. This is a national organization for the training of workers. It is nationally well financed because of a special tax, and it has regional offices in all of the main cities of the country. SENA could provide services to industries of all sizes. We are trying to develop a liaison between IIT and SENA so that we can provide training to the trainers of SENA and also furnish technical assistance or support to their people who work in extension services. We also hope that SENA will refer the small industries to us for obtaining technological services.

MR. BLACKLEDGE: Dr. Ayala, would you explain what you have done with SENA in the area of bakeries?

DR. AYALA: We started operations with the bakery industry about ten years ago under the UN program. SENA later started a program for the bakery industry.

In the first stage, we prepared a special program for the technological training of the SENA instructors. SENA asked us if we could also provide some theoretical and practical training, so we prepared a special course and a manual. In the second phase, we developed a project for composite flours so that we could substitute other foods of local production yet maintain the nutritional quality of the flours and the bread. We experimented with the industrial production of the flours and tested the results with the bakeries.

IIT did not have the administration to support the training of bakers, but SENA did. We invited SENA to send the instructors to our institute and to our experimental bakery so that they could then transfer this knowledge and technology and also see if they could find problems that we could attempt to solve. After that operation, all the practical work with bakers was done by the instructors from SENA. We

think that we would like to try this kind of cooperation in other fields.

MR. KITCHELL: Obviously, every country has and needs an industrial, institutional infrastructure, and ideally it would operate with a systematic approach toward industrial growth and development. But we are dealing with an imperfect world, and many important components of the system are missing in developing countries by definition. And the question is not assistance to small industry. The question is whether an IRSI, which by our common definition is an institution that provides a variety of services, one of which is R&D work, is the most effective institutional arrangement for providing assistance to small industry. It does not mean to suggest that it should never be concerned with small industry, because the relationship between the size of the industry and the sophistication of the technology involved is not necessarily a direct one. You can be dealing with small industry in a high technology area, and small industries have a way of becoming big industries if they are successful.

But the question arose in our evaluation whether those IRSIs that seem to have reached a viable existence are basically those that have stayed away from small industry because their resources could be easily and quickly dissipated among the myriad needs.

DR. BLACK: I think that one should not go too far in trying to come up with theoretical prescriptions for some abstract situation that is not spelled out. If you look at each country, you will find a unique environment with a unique set of structures, unique organizations, and unique opportunities. It is from this basis that one ought to start thinking whether the ARIs should or should not serve small-scale industries.

One of the most interesting programs that I have found serving small industry is the International Rice Research Institute. Its agricultural engineering program is directed largely toward small-scale metal-working firms in Asia. It has been an extremely successful program in building up the small-scale metal-working capability, particularly in the Philippines. It has furnished designs and has worked with industry to improve these designs. Largely as a result of the IRRI's activities under this program, small-scale industries have developed their own design and development capabilities. This is just one example, but it is a unique situation and a unique organization that is responding to a specific environment.

MR. KITCHELL: Obviously, everything that we are talking about is subject to local conditions. All I am saying is that most of the IRSIs that are established today are operating at marginal levels. Why is this so? One of the reasons I am suggesting is that they have spread their resources too thin and one way of doing this is to get too involved with small industry.

MR. MOELLER: I have a small problem with both of you gentlemen. Dr. Black used the word "unique" too often. If all of these situations were unique, this conference would be an utter disaster. We are here because

we are not all unique. We do have common ground, common interests, and great similarities, and common objectives in some limited sense. However, I will admit that local conditions do play a significant role in how small- and medium-sized industry is assisted and the type of role that an IRI may play.

Now, I am going to submit that the benefit to the IRI (industrial research institute) from working with small- and medium-scale sectors is probably larger in terms of institutional development. The reason for this is that the demand, which is what drives institutions to developing capabilities, is more varied, covers a wider spectrum, and has a tendency to push IRIs toward frontiers of service. The larger industries frequently have a choice. If it is available at IIT, fine, but if it is not, the larger industries can do it themselves. Small industries frequently do not have that choice, which places a tight demand on IIT. This can be useful to IIT in that it creates a constituency. It goes beyond this, too. Small-scale industry soon becomes interested in projects that are not fundable because the proposals do not have credibility. An IRI, with a relatively small amount of work, can add credibility to that proposal and make it fundable. You have now created, in fact, an expanded clientele in the financial community.

I think that opportunities in this area are much broader and have more potential benefit in the long run to the IRI than just the business of doing good for the small industries. One day those industries will grow bigger and be able to pay more of the load.

DR. BLACK: I would like to ask Mr. Sewell to comment on the Georgia Institute of Technology. That organization began to serve small-scale industry and to develop a constituency, and I was wondering if there are any parallels between that situation and the situation within a developing economy.

MR. SEWELL: The program at Georgia Tech began about twenty years ago with a survey of about 200 small manufacturing firms. The objective was to determine their problems and needs. Out of that survey emerged a number of conclusions, but the primary need for service was determined to be in the area of management. Based on that, we organized and began what was one of the early industrial extension management technical service programs. Georgia Tech had always taken great pride in being a sophisticated organization with some esoteric work going on in its labs, but it had been missing a grassroots constituency.

Our program of service to small industry grew beyond anything for which we had hoped, and it had an odd by-product. It created that constituency in a way that we had never anticipated, and the creation of the constituency had not been a goal. The goal was to help the growth of small industry. But we did, in fact, find that the Georgia Tech program was almost a sole source of help. Over a period of years, this led to a fair amount of contract work funded in this particular case by the U.S. Department of Commerce. Another by-product was that the work done with small industry provided an input into the research labs of Georgia Tech that perhaps might not have been obtained otherwise. We

found that it was not in conflict and that, as a matter of fact, it offered a useful and pragmatic supplement to the larger work of the institute.

WOMEN IN DEVELOPMENT

Melinda Cain
28 November 1979
Ruth Flynn, Chairman

The reason that a Women in Development activity was included in the contract is because of the Percy Amendment, which states:

In recognition of the fact that women in developing countries play a significant role in economic production, family support, and the overall development process, U.S. aid shall be administered so as to give particular attention to those programs, projects, and activities which tend to integrate women into the national economies of developing countries, thus improving their status and assisting the total development effort.

This view of women in development is a complete and enhanced utilization of human resources and development. In other words, by giving technical assistance to women who are actively participating in development, their participation in the overall development of the country will be enhanced.

In response to this particular mandate, two basic objectives were established: (1) to enhance the ability of women in ARIs to perform more effectively in their current positions; and (2) to assist them in promoting the flow of technology to local users. To meet these objectives, two general cadres of activities were developed. The first was an enhanced recognition of women in DRI's contract activities, in particular, information and management development programs. DRI actually became a source of information on women in other developing countries, and this information was made available to developed country research institutes and other agencies. At the same time, DRI supplied information on U.S. activities geared toward women that was requested by women in developing countries. Examples of information exchange that occurred include a conference sponsored in Tucson, Arizona, by AID. This conference focused on women and their role in food and nutrition in developing countries. It was of great interest to a woman at IIT, and DRI became a prime vehicle for making the papers from this conference available to her. A couple of requests were also made by Thai women who are interested in women's study programs and battered women's centers in the United States. They were put in contact with people in the United States.

The second type of activity took the form of a planning methodology that was developed and made part of what is called the Development Training Forum (DTF). The planning methodology involved six steps:

- Vision, in which the dimensions of the topic to be discussed were created;
- Contradictions, or determination of the underlying problems and obstacles to vision attainment;
- Proposals, or development of major strategies to address contradictions;

- Programs, in which action-oriented programs are developed;
- Tactics, which are the definitive activities to implement the program;
- Scheduling, which is the establishment of these activities on a time line.

One of the workshops held in Thailand focused on the role of women in rural development. It was felt that there was a need to examine ways in which the institute could supply technology to help the ultimate role user. It was an attempt to test a conceptual model. DRI was working with TISTR, trying to develop the institute's managerial training. In this instance, the planning methodology was based on local needs. The institute itself would come in contact with transfer agents, and in Thailand these were the National Women's Council of Thailand and the Thailand University Women's Association. These organizations were conducting active community and rural development work and had access to people who needed technology. In fact, one of the problems that research institutes may encounter is a lack of direct access to the local users of the technology. Therefore, the Women in Development program was aimed toward linking the transfer agents with access to technology. This would hopefully create a two-way flow of information in that rural users could describe their needs, resources, and capabilities to the transfer agents. This knowledge, in turn, would help in designing, adapting, and channeling technology to rural areas.

The program was also an attempt to establish a training forum for women to understand the possibilities, identify the problems, and begin planning solutions to the problems. In other words, it was an attempt to move women into actual planning and managerial roles.

The planning methodology is simple and versatile enough so that it can also be applied to various organizations at different levels. The reason for its simplicity is that practically every step has the same internal structure.

The first step examines the ideas of the whole group--it is essentially a brainstorming session that allows all group members to participate. The second step is to organize all of the ideas from the group so that participants can deal with them, and the third step allows the naming of the groups, which is a way of handling data and helping the participants to work with it.

In Thailand, three workshops were held, the first in July 1978. It was a six-day forum that focused on the role of women in rural development. The participants felt that this was an important topic. The sponsors were TISTR and the National Council of Women in Thailand (NCWT). The NCWT has about ninety-two affiliated organizations that have worked throughout the country. It is a well-recognized infrastructure of voluntary organizations. Twenty-five women representing private organizations, governmental agencies, and TISTR attended the workshop. Emphasis was on training in the planning method, but the workshop also included a review of current programs that involved women in rural development. One session discussed the methods and skills necessary for project implementation, and another one was presented on

how to prepare a proposal. It was felt that planning tools are important, but without a method of implementing those tools in an actual situation funded by an agency, it would be difficult to see if those skills could be used.

The second workshop was held in Phuket and was presented in Thai. It was conducted primarily by the Thai trainers who had been trained during the first forum. By training a core group of trainers, the chances for success are greater, because the native trainers have the language capability to spread the training and are better able to find the people and work with organizations. The second workshop lasted for six days, and sixty provincial-level community leaders and regular workers participated. The forum focused on the planning method and its application to large groups in addition to problem solving and evaluation techniques.

The last forum was held in Bangkok and brought together governmental and nongovernmental representatives from the ASEAN nations. The program focused on the interaction of the various organizations in the area of child development. This was felt to be a pertinent topic, particularly since it was the International Year of the Child. The workshop lasted for four days and was concerned primarily with program design and implementation and on how to establish priorities. Concurrently, the women who had been previously trained held a general meeting for the National Women's Council. Two hundred provincial-level representatives from their organization attended. The three-step version of the planning method was used, and DRI staff observed, advised, and helped to evaluate the session.

The first forum in Colombia was held in December 1978 and focused on the role of women in food and nutrition. All of the Colombian workshops were conducted in Spanish. IIT and PAN (the National Plan for Food and Nutrition in Colombia) sponsored the first workshop. Thirty-two representatives from the institute and from local universities, primarily nutrition teachers who were interested in working more closely with PAN, attended. Also, representatives from the central and field offices of PAN not only participated in the seminar, but also talked very frankly about their work. Several affiliated organizations of the National Council of Women of Colombia also participated. Three days were spent on the planning method.

The second forum was held for three days in October 1979 and focused on technology for the development of self-help programs. The sponsors were IIT and DRI, but it was difficult to continue collaboration with the National Women's Council of Colombia. Nevertheless, work was done with the Coordinating Council for Voluntary Organizations in Colombia, which has a very well-defined and established infrastructure. Twenty-four representatives from their training committees participated in the workshop. Training focused on the use of the planning method and how to teach the planning method to others.

The last workshop was concerned with technology for programs and self-help activities in child development. Again, the International Year of the Child was important in Colombia, and five days were spent

with representatives from the community development level of voluntary organizations. Emphasis was on using the planning method, and several sessions were allowed for actually practicing the methods.

The total participation in these forums was almost 400 people. In Thailand, over 300 people attended, and in Colombia, almost 100. This was felt to be a large number of actual direct participants, and if every participant trains others, a multiplier effect will have been created. Local replication of the workshops has already occurred. By the time the second workshop was held in Thailand, seven to nine replications had been conducted in the country. It is not possible to evaluate replication in Colombia since the workshops were only recently held. However, the potential is good.

Regarding modification of the method and application to other contract work, the DTF has been used in other DRI contract work; for example, it was used with Egyptian researchers and with Jordanians from RRS.

Cultural and social factors also need to be considered. For example, in Colombia it was somewhat difficult to get people to arrive on time, and in Thailand, much time was spent in ceremony. These kinds of situations require flexibility on the part of the trainers. It is necessary to adapt to local conditions and customs.

Language was another significant factor. It may not be as effective to teach in English as in the language of the country involved. It seems that the Spanish participants were better able to grasp the knowledge even though it was being transmitted simply. They were able to work with the method better than the Thai participants who were taught in English.

The scope of impact is difficult to measure. Hopefully, many organizations will use the method, since a variety of organizations were represented at the workshops.

The method was modified a number of times according to the number of participants and to time. In some instances, the order of the steps was changed, and at other times sessions were added or explained in a different manner. The application to the local level was inherent in the method. It is believed that the method also has the potential for cross-cultural application, with global implications. It supports the trend toward global equity and equality because everyone that uses this method has a chance to participate.

A number of lessons have been learned from this phase of the experiment.

- It is important to clearly define the topic of the workshop and the desired outcome. A pre-forum consultation, visit, or discussion of the topic is important.
- An entry point is necessary. In other words, it would be difficult to approach any country without the assistance of a

- linked institute or organization. It is essential to understand the local conditions, especially the local political situation, in order to conduct effective training.
- The continuity and support of a local entity is extremely important. It is one task to do the training, but it is another to have a local institution that is willing to perpetuate and conduct follow-up activities with the training that is given.
 - Modification of the method is necessary. In particular, more money should have been budgeted for impact assessment and follow-up. Some kind of assistance is extremely useful in insuring the continued use of the method in the country.
 - This method could apply to other countries. It also has broader application within the countries with which DRI worked.
 - An in-depth review of the data collected in the workshop would be useful. For example, if the AID mission in Colombia were equipped to fund activities for volunteer organizations, they could study the last two reports done in Bogotá. These reports provide an array of activities, programs, and capabilities of volunteer organizations.
 - Additional sessions should be added to the basic six-step method in order to help ensure that the planning skills are implemented. A comprehensive training program might be a way of perpetuating and using the method. Such a program could be useful for the Peace Corps, which faces problems on approaching the local community and determining what needs to be done.

To conclude, the program initially focused on women, but ended up developing a planning methodology applicable to people in general in developing countries, thereby enhancing human resource utilization.

DISCUSSION

CHAIRMAN FLYNN: Dr. Smith, how did you experience this program in your institute? Was it of value in strengthening the institute?

DR. SMITH: The conditions in Thailand may be different from those in other countries, because in Thailand women participate in almost all of the activities. We have a number of women students, graduates from the University, and in some fields, such as science and accounting, there are even more women than men. Women are also trying to gain a majority in engineering. Therefore the situation is somewhat different--the women do not really need any encouragement. However, the DRI training program is useful because it helps women to participate in the development of the country, especially in the rural area. Women's participation in the rural area is low.

I did not personally participate in this program. However, I obtained the report showing that the women's organizations participated in the program and showed interest in continuing the training by themselves into the provinces. Thailand has seventy-one provinces, and we encourage the local women's organizations in those provinces to

conduct the training program. We would serve only as the consultant or adviser in such activities.

I would say that we were very satisfied and that the program would be continued in local areas.

MR. SEWELL: You used the ARI as the entry point to a subsequent infrastructure?

MS. CAIN: Yes. I think that it was partly because of our intervention or offering of assistance that the local research institute became aware of the established infrastructure in the country. I tend to think that IIT, for example, was not aware of this coordinating group of voluntary organizations. However, once it realized the work that they did, the possibility existed for a response from the research institute.

DR. AYALA: When we started talking about this program in Colombia, I was a bit apprehensive because of political reasons. Also, our institute does not differentiate between male and female professionals. We had never had a specific program for women so were somewhat nervous about it. In any case, we insisted on conducting the pre-forum activities. We invited different types of women's organizations representing both the government and the private sector. In this way we could discuss the problem so that they could understand the purpose of the program.

The two programs were different. The first one was attended by a mixture of people from different institutions and, of course, different backgrounds. After the first seminar, we thought that the second exercise would be organized directly by the National Council, but, as already mentioned, we had some difficulties because the council does not have a real infrastructure in the country. Although I could not attend the second program, it was a success. I met with the woman president of the national organization, which is represented in every department (or state) of the country, and we intend to discuss the possibilities of using this organization as a means of technology transfer through these activities.

MR. SEWELL: To what extent has it been possible to consider support programs for women employed by the research institutes?

MS. CAIN: In this particular program, we did not focus solely on the women within the institute. The reason is that before we developed the program, we asked the women within the institutes what kinds of programs would interest them. They did not want a special program just for women. The women felt that they had access to the training and to the seminars on management development and other topics.

MR. SEWELL: They did not feel that their needs were unique?

MS. CAIN: No. We took a direction in conjunction with the two women at IIT and TISTR who actively expressed an interest in helping women to have more confidence in their own skills and in working with outside organizations. We did not impose this upon them. It was the thought

from the women within the institutes that this was a more productive activity.

DR. BLACK: I think that the women in the research institutes in the developing countries, particularly in Asia and Latin America, have experienced less discrimination in terms of professional advancement within the organization than women in the United States. Women moving up in R&D or contract research organizations in the United States have experienced considerably more discrimination than women in the countries in which I have worked. Very few research institutes in developing countries do not have women in senior positions. I have not known until recently of a woman being at the level of, say, a division head in a U.S. institution.

[This concludes the discussion accompanying the presentation on Women in Development.]

R&D MANAGEMENT DEVELOPMENT

Ronald P. Black
28 November 1979
Dr. Smith Kampempool, Chairman

One of the perceived weaknesses of S&T organizations in developing countries was in the area of management. This was easy to understand, as these are among the most difficult types of organizations to manage--and the difficulties of managing them are not confined to developing countries. Several reasons explain this problem:

- Many, if not most, of the R&D institutes' projects and activities are nonrepetitive;
- Because of unknowns in research, engineering, and environmental response factors, uncertainty is greater concerning the outcome of projects of R&D institutes than is so with the output of most other types of organizations.
- The product of an R&D institute is largely a mental output as opposed to a physical one. Thus, similar arrangements of factor inputs in R&D will not necessarily give the same results. This compounds the uncertainty associated with the management of R&D institutions.
- The staff of R&D organizations tends to be creative and individualistic. The productive management of such people calls for imagination and flexibility beyond that called for in the management of many other kinds of organizations.

The experimental R&D management program element should be differentiated from the management development activities aimed at the staff and management of DRI's linked institutes. The latter was discussed in an earlier session under the context of staff development. The major objectives of the experimental R&D management program element were twofold:

- To discover optimum methods for training institute executives.
- To find appropriate mechanisms for initiating indigenous R&D management development programs and for training local instructors.

Other project considerations affected how these objectives were pursued and to some extent complicated the task. These will be mentioned later.

DRI's approach to the first objective was to conduct management workshops for institute executives in various regions of the world, and, in doing this, to experiment with workshop variables or factors. These included:

- Workshop objectives
- Techniques for selecting participants
- Nature of the instructors
- Training techniques
- Nature of the course materials

- Participant involvement
- Seating arrangement
- Length of workshops
- Number of participants
- Combining workshops with projects
- Evaluation and follow-up techniques
- DRI's management of the project

In pursuing the second objective, that is, finding appropriate mechanisms for initiating indigenous R&D management programs and for training local instructors, the following activities were planned:

- Select three institutes to assist in developing an indigenous R&D management training capability. These institutes were to be in three different regions of the world.
- Conduct one of the experimental regional workshops at each of the selected institutes as a demonstration.
- Conduct a six-week training program in Denver for persons from each of the three institutions who would subsequently take the lead in conducting a second regional management workshop at their institutes.
- Assist the three selected institutes in conducting a second experimental R&D management development workshop.

The activities aimed at achieving the two objectives are intertwined. It should be noted that in addition to the program being an experiment, AID and DRI also wanted it to have as large a positive impact as possible on applied research institutes worldwide. This, of course, strongly influenced the entire program design.

The first workshop was co-hosted by IPT, the second by TISTR, and third by TUBITAK in Turkey. It was hoped that each of these institutes would develop an in-house management training capability and that they would largely take the responsibility for conducting a second regional R&D management workshop, including providing most of the faculty. As it turned out, only TISTR, among the three, did.

The cause of the low success rate may be attributed to the following:

- DRI lacked perception regarding the difficulty of improving management capabilities and particularly in training others to do so.
- Consequently, communication was lacking between the three institutes and DRI in terms of work and commitment needed from the institutes.
- In some cases, there was a lack of common goals between DRI and the involved institutes.

As a result of the first three short courses, a number of lessons were learned about conducting R&D management workshops. The first has to do with selecting workshop participants. In the first two workshops, DRI and the co-hosts identified the institutions and subsequently the directors who were to attend the workshop. Invitations were sent to the

workshop directors--giving them the option to substitute their principal deputy if they could not attend. In the third workshop, held in Ankara, another mechanism, more political in nature, was used. In 1974, a number of joint economic commissions were set up between the United States and Middle Eastern countries. The U.S. State Department heard of the upcoming Ankara workshop during this period and suggested that where joint commissions existed, the U.S. commissioner issue the invitation through his counterpart Middle Eastern commissioner. In the spirit of an experiment, AID and DRI agreed. The result was that none of the Ankara workshop attendees, invited through the political mechanism, even worked for a research institute--much less were they institute directors, for which the workshop had been designed. Consequently, dissatisfaction was considerable. This was undoubtedly the low point for this program element. The lesson is that, when possible, the role of politics should be minimized in planning S&T programs.

The second lesson concerns the nature of the material presented in the R&D management workshops--specifically, its relevance to the participants' everyday jobs. While the ability of individuals to transfer concepts and lessons from strange contexts varies considerably many developing country R&D managers, having been trained in the fields of engineering or science, have difficulty in seeing the relevance of management concepts, techniques, or lessons unless these are portrayed in the context of a research institute. Some need to see the lesson, concept, or technique demonstrated in the context of an institute within their own country before it has relevance to them. This variable, however, is country sensitive.

In the United States, it is taken for granted that participation on the part of trainees is good and will help them to grasp concepts, learn techniques, and be better able to apply them. When this program was initiated, it was not known whether developing country research institute management would respond to such techniques. By and large, they did. Problems did occur, but they were isolated.

A factor that affects participant involvement is the seating arrangement of the workshop. This was not surprising to DRI, but some of the co-hosts did not believe it important and arranged facilities such that participants sat in a classroom configuration. This, of course, restricted participant interaction.

As this program started, another question was, how receptive would institute management be to some of the more advanced management training techniques, such as the case study method, management games, in-basket exercises, and role playing? Again, by and large, participants were quite receptive even though the methods were in many cases new and strange to them. The only exception to this was the workshop in Turkey, where some of the participants exhibited open hostility toward the idea of participating in case study analyses or making management game decisions.

Optimum workshop length and number of participants are very much a function of the workshop's objectives. They are also judgmental issues and depend on a number of other complicating factors. The first three

workshops were aimed at providing institute executives a refresher overview course in R&D institute management. A two-week workshop is judged to be optimum for this purpose. On the one hand, it is difficult for people at this level to leave for more than two weeks. On the other hand, a substantially shorter period will not allow for sufficient program depth. Concerning number of participants, if one of the goals of the workshop is to make it a participative experience for each of those involved, a group of twenty-five for a two-week program is a good "rule of thumb."

After the Thailand workshop, participants utilized, at their own institutions, approaches that had been discussed at the workshop for increasing their institute's effectiveness in working with industry. This was another aspect of the experiment. The areas that surfaced during the course of this workshop were industry seminars, institute-industry staff exchange, industrial liaison, in-house seminars, industry subscribers, and internal evaluation of their programs. It is DRI's experience that if participants will make a commitment to utilize concepts or lessons learned at a workshop--perhaps in the form of a written plan--and if follow-up visits are scheduled, then the chances that the participants and their institutes will benefit from a workshop are significantly increased.

DRI also experimented with three forms of evaluation and found each to be useful in its own way. These were at the reaction, learning, and behavioral levels. At the reaction level, it can be learned immediately what participants think, and when employed during the course of the workshop, these evaluations can often help to implement improvements, particularly in organization and procedure. For example, if the participants are having difficulty understanding one of the faculty members, or if they would like the instructors to use flip chart rather than a blackboard, these changes can be made. A learning level evaluation is best conducted at the end of a workshop. This reveals how well the participants understood what was presented. One good approach is to have the participants analyze case situations embodying the more vital concepts included in the workshop.

More important, however, is how the participants' actions and behaviors are affected on their return to their institutes. DRI's experience suggests that to enhance the likelihood of a positive evaluation at this level, (1) the participant should be informed during the workshop that a follow-up evaluation will be made; and (2) the participant's superior should be actively involved in the evaluation. If the participant knows that he is to be evaluated at the behavioral level by a workshop leader and his superior, he will make efforts to make the evaluation positive; that is, he will attempt to implement workshop concepts, practices, and techniques. The perhaps subtle aspect of the second condition is that quite often there is little a participant can do to implement workshop ideas unless his supervisor agrees. In fact, in many developing countries, a person would not have the temerity to even suggest changes to his supervisor without first being asked--thus, the reason for bringing the supervisor into the evaluation. In the workshops for institute executives, this latter condition was not as important, but as one moves down in the management structure, it becomes increasingly important.

The next activity of this program element was a workshop in Denver for the persons who were to lead the second round of workshops. As an aid, a handbook on conducting R&D management workshops was drafted. The Denver workshop was a six-week course with representatives from TISTR, IPT, and the Laboratoire Central de Tunisia. At the request of the director of LTC, the second Middle East/North Africa workshop was to be held in Tunis. The director of LTC attended the Denver workshop.

A workshop in Karachi was co-hosted by PCSIR and was used to test the lessons learned in previous workshops while the final three workshops continued the experimentation--primarily with workshop objectives, local faculty, and workshop leadership.

The second Thailand workshop began the experimentation with objectives. One of the concepts that had emerged during the first Thai workshop was that of establishing a network of contract research institutes within the ASEAN countries. One day of the second workshop was used for a group exercise in examining and analyzing this new approach, and an informal network was indeed formed. The final workshop in Indonesia--the Indonesian Department of Industry institutes taking the lead in planning, organizing, and conducting the program--was focused entirely on the management area of marketing joint ventures for the network institutes. Suffice it to say that lessons learned during the first series of workshops seemed to be equally valid as the objectives of workshops changed.

With respect to host country leadership in conducting the second series of workshops:

- They universally did a good job in organizing workshop facilities, logistics, and such.
- Most did a good job in planning workshop content--no one did a poor job in this respect.
- The local faculty contribution was varied.

Related to the last point, TISTR, at the second Thailand workshop, invited the Thai National Institute of Development Administration to assist in providing the workshop faculty. This was an interesting approach to developing a local cadre of R&D management trainers. On the one hand, the professional management trainers know management in general but probably know little about the special characteristics of R&D management--this they can gradually learn through their association and work with the professional R&D managers. On the other hand, from experience, the R&D managers know about R&D management but probably have little experience in structuring their special knowledge into management training modules--the management trainers can help them with this. There was not sufficient time or resources to experiment further with this approach under the present program, but it deserves further consideration.

To summarize the results of the R&D management program, the first objective--to discover optimum methods for training institute objectives--seems to have been achieved. Evidence of this accomplishment is the handbook.

The second objective--to find appropriate mechanisms for initiating indigenous R&D management development programs and for training local instructors--was only partially achieved. Indonesia participated in this program and is now developing a management training capability. TISTR has initiated its own inhouse management training program. IPT in Brazil has developed a capability in conducting management training. DRI has been told that IPT's doing so was somewhat influenced by the first workshop held there in 1973. Also, IVIC in Venezuela participated in the Latin American workshop and has developed a management training capability. This institute has subsequently had other training at DRI in the management area. DRI also recently formed a linkage with CIEPE to provide management training and to help the institute conduct management training programs.

DISCUSSION

MR. MOELLER: As the management jargon or terminology is learned within the research institutes, and as they begin to understand management techniques, it is a relatively important but short step to understanding the problems of your clientele and how to assist them. Could this program be expanded to encompass not only the institute's management, but the management problems of its clientele? For example, the problem of managing a small production organization dealing with fruit pulp is in some respects a simpler management problem than running a research institute. But would it be worthwhile to try to bring this capability into your institute in some small organizational increment?

DR. GHANI: I think that it is a good idea.

MR. MOELLER: Dr. Ayala, your institute already does a little of this, correct?

DR. AYALA: Yes.

DR. BLACK: This is one of the envisioned elements of the program that we will have with CIEPE, because they wish to provide management training to their industrial clients. But not all institutes think that this is a part of their mandate or something in which they should be interested. There is no a priori reason that one should think that they would want to be involved in management training.

MR. SEWELL: Dr. Black, do you envision yourself ever working with the universities in a joint training effort?

DR. BLACK: In Indonesia that is exactly what has been done. Two universities have been chosen, one in Sulawesi, which is in the eastern part of Indonesia, and one in Medan, which is in the far western part, and their professional management schools have been involved in the program. In fact, Hasanudin university in Sulawesi was the host of a workshop last year in which the university was the primary organizer of the workshop and participated heavily in conducting it. The plan was to introduce R&D management into the curriculum after the workshop had been conducted. I do not know how far this plan has been carried forward.

MR. EVANS: A series of four workshops will also be conducted in Cairo commencing in January in which part of the teaching staff will comprise representatives of the National Research Center and the Academy of Scientific Research and Technology. They, in turn, have engaged Cairo University, American University of Cairo, and other educational institutions in preliminary discussions for establishing this kind of a joint pedagogical venture.

DR. BLACK: An interesting aspect of our program with the National Research Center is that we have recently jointly submitted a proposal for what will be a multimillion-dollar management training program for the GOFI, the organization in charge of administering Egypt's state enterprises.

MS. ACHMAD: In connection with this, I would like to return to your second objective. You say that you have not achieved as much as you would like to have achieved. Is this because the second objective is actually more the responsibility of the country involved, and therefore efforts should come more from the national side? Perhaps the external efforts will complement the national. Therefore, I think that the training course in the university will help to achieve the second objective more than any other way. For example, in Indonesia we have only a business management degree; if we could expand this into R&D management, it would help to achieve the second objective because it will be more of a national effort.

It is very difficult for people from the outside because more than the technique of managing the research institute is involved. The legal system of the country is very much a part of R&D management. In small enterprise management, the legal system is involved considerably, and R&D workshops will probably not help much. The effort will have to be a continuing one and be well-integrated with the legal system. However, it still seems that it will be worthwhile to develop a course in R&D management.

DR. BLACK: In Indonesia, a number of steps are being taken to stimulate R&D management through administrative and policy procedures. For example, a number of the ministries are now giving credit toward promotion for having attended a LIPI-DRI R&D management program. The Management Development Handbook has also been translated into Indonesian.

CHAIRMAN SMITH: By formal education scientists or engineers have not been trained to be managers, but after they have worked at an R&D institute for some time, they are promoted to managerial or administrative positions.

MS. ACHMAD: Therefore, I think that permanent courses in R&D management should be available.

DR. SMITH: Do you think that it should be a degree course?

MS. ACHMAD: It should be both, because some people with Ph.D. degrees, after working for several months, may be appointed director, even though

they have no management knowledge. This happens in the developing countries. And if management courses are offered at the university, a director can take the courses. Actually, management development is a continuing process. Probably every one or two years, people should take these courses to learn new techniques and developments in the field.

[This concludes the discussion accompanying the presentation on Management Development.]

RESEARCH GRANTS

Donald D. Evans
28 November 1979
Dr. Ghani, Chairman

The research grants program was conceived as a means to stimulate the effectiveness of research institutions in the developing countries in R&D activities as they relate to industry and other users. It had been observed that in too many instances, a significant lack of relationship existed between what occurred in the research laboratory and what was ultimately shown to be useful and commercially viable in the economy.

Specifically, the research grants program was structured to provide, in selected instances, catalytic amounts of funding and technical assistance to enable the grantee institution to carry out highly directed research having specific commercial or other objectives that would demonstrate the utility and effectiveness of developed or adapted technology. It had been observed that in many cases, otherwise practical research projects were delayed or prevented by the absence of relatively small amounts of "hard currency" to provide equipment or technical services from foreign specialists. The grants program was therefore intended to experiment with modest infusions of such capital under regulated conditions to determine if this procedure would show results.

Over the course of the project, ten grants to eight different institutions in as many developing countries were made. The results ranged from failure to appreciable success, demonstrating the value of the method and resulting in recommendations for further experimentation and use of the concept.

Although the grants program was a natural concomitant of the other aspects of the DRI program, including linkages, management training, and information services, it was conducted independently of them in order to provide a wider base of experience. It included institutions that for various reasons otherwise might not have been included in the DRI program. However, several of the institutions that were involved in other DRI activities were also incorporated into the grants program.

Several criteria were used to select grantee institutions:

- The proposed R&D activity needed to show reasonable promise of being commercially or otherwise useful to the intended user.
- A number of projects were to be included that reflected the "appropriate technology" concept in that they were to result in labor-intensive technologies, to have minimal capital requirements, to be widely applicable in rural areas, and to benefit principally the least advantaged strata of the population.
- A fairly broad geographic distribution of the participating institutions was required.

- Some relatively sophisticated technologies were to be involved.
- The proposing institution was required to show evidence of sufficient technological and managerial competence and interest in the project to assure its ability to carry out the proposed program.
- The technologies involved were to cover a spectrum of product areas.
- Another agency was to have a role in the actual application of the research results. This was to be a private or governmental entity that could but was not required to take a financial interest.

The initial round of proposal solicitations involved issuing letters of invitation to submit proposals. The list was garnered from the membership of the World Association of Industrial and Technological Research Organizations (WAITRO). The resulting proposals (thirty-four were received) were reviewed by a select panel of U.S. institutions (Battelle, Arthur D. Little, and Southwest Research Institute) and were judged on their technical and other aspects. From this process, eighteen proposals were selected for final consideration, out of which five institutions were selected to receive grants.

In the second and final round of proposal solicitations, it was decided that preliminary visits would be made to specially selected institutes in order to determine their qualifications and interest and to identify possible proposal subjects that would conform more closely to the desired range of subject matter. This method was also used to avoid the problems that had arisen in the first solicitation process when thirteen otherwise meritorious proposals went unrewarded because of funding limitations.

Results of the proposal generation activity in both instances provided useful information. Negative observations included the following:

- Deficiencies in meeting proposal requirements, lack of consistency and sequentiality in writing, and problems with language occurred.
- Estimates of the costs of the proposed R&D, preparation of adequate estimates of staffing requirements, and development of a logical and consistent sequence of project steps were absent.
- A lack of economic analysis and the relating of the proposed R&D to national development goals, sponsor interests, and internal institutional activities often occurred.

Although the research proposals, particularly during the first round of solicitations, were varied and insufficient, the reports of completed grant-supported R&D projects were generally more consistent and of better quality than the corresponding proposals.

The research to have been performed by the Federal Institute of Industrial Research (FIIR), Lagos, Nigeria, was the development of a

malting process utilizing locally grown barley as replacement for imported wheat in the brewing of domestically produced beer. The DRI grant was to have provided equipment required for the laboratory malting and fermentation work. This equipment had a value of approximately \$15,000, and DRI arranged for its purchase and shipment.

Communications with the FIIR were extremely tenuous, but it was finally determined that only two of five shipments had ever been received at the Lagos airport customs house. The FIIR stated that it had never received notice of arrival. In subsequent communications, the FIIR asked for replacement of the equipment plus the addition of new equipment whose cost far exceeded available funds. At last communication with the FIIR, some laboratory fermentation work had gone forward, but the project could not be completed. This project represents the least satisfactory of those that were attempted.

The proposed research of the Council of Industrial and Scientific Research, Accra, Ghana, was to have involved a feasibility study for the design and production of hand pumps. The objective was to produce dependable, low-cost pumps with a high ratio of indigenous materials and labor, to be widely used in rural areas. The grant also called for inspection trips to sites of major installations in other countries as well as an extensive literature review and travel and per diem expenses for the field visits. Again, delays and communication problems interfered with the project. But most detrimental was the instigation of two coups in Ghana that raised questions about the disposition of grant funds and the possibility of performing the work within an acceptable time frame. This ultimately resulted in abandonment of the project.

The grant to the Dominican Institute of Technology in Santo Domingo, Dominican Republic, was never made because of intervening circumstances. The project involved studying the feasibility of recovering waste heat from a slag dump of the Falconbridge ferro-nickel plant. The project was not realized because of the demands of Falconbridge and the restrictions that it intended to impose on doing the necessary research within its plant facilities. The company also was going to require exclusive access to the results of the work--a condition that was not possible under terms of the use of AID funds.

The National Institute for Chemistry, Bandung, Indonesia, submitted a proposal for studying the feasibility of upgrading and standardizing the production of tempe in Java. Tempe is a partially fermented product made from soybeans and is a low-cost, principal source of protein for low-income persons in the country. The objective of the proposed R&D was to develop designs for better equipment, to devise more sanitary production methods, and to provide better standardized cultures with which to initiate fermentation. The work was to involve the local cooperatives of tempe producers and was to be disseminated through their assistance. However, both versions of the proposal were unsatisfactory, despite a personal visit to Java to discuss proposal content and format. When improvements were suggested in writing, no response was made, and DRI concluded that interest was insufficient to pursue proposal development.

The Institute for Technical Investigations (IIT), Bogotá, Colombia, participated in two grant projects. The first one concerned the development of a method for neutralizing a highly caustic and toxic refinery effluent that was being discharged into a tributary of the Magdalena River, a major source of domestic water. A private firm of consultants approached IIT with a proposal for a joint development effort on a process that could be marketed to refinery management. However, the refinery, owned and managed by the government, declined to participate in the financing of the necessary treatment facility. IIT is currently trying to interest other refinery operators in the process.

IIT also undertook to study the feasibility of adapting extrusion cooking to the production of pastas for consumption by low-income Colombians. The grant to IIT supported a series of tests at the Korea Institute of Science and Technology on its own designed version of a small-scale extrusion cooker. IIT engineers were present at these tests and exchanged information with KIST. The test demonstrated the feasibility of the concept and led to a proposal for construction of such a machine by IIT. At the same time, a market study was conducted in Colombia that indicated the number of machines that could be expected to be sold within the country to existing pasta manufacturers.

DRI worked with IIT in a marketing effort and sought financial support from U.S. and other organizations to build a prototype machine and demonstration production facility in Colombia. Agreement was reached with a local manufacturer of food production equipment to meet 25 percent of the cost of this work in return for first option on producing the prototype equipment commercially.

A grant was awarded to the Thailand Institute of Scientific and Technological Research (TISTR), Bangkok, Thailand, to procure a commercial-scale chemical process vessel for use in developing a process that will stabilize the oil that can be extracted from the seeds of rubber trees. This stabilized oil is a suitable substitute for linseed oil, which is presently imported for paint manufacture. DRI located, refurbished, and shipped the pressure vessel to Thailand. The process was introduced to an industrial firm in Thailand. At present, the firm is studying the feasibility of setting up a commercial operation.

The Central American Institute of Industrial Investigations (ICAITI), Guatemala City, received two grants. The first supported the development of a process to treat cottonseed cake, a livestock feed, to destroy the toxicity produced by an enzyme present in the product. The treatment process was known, but it was necessary to design an efficient system at acceptable cost. With technical assistance from DRI and help in acquiring special components, a successful prototype was designed, built, and tested.

ICAITI also developed a theoretical heat transfer model of a small-scale solar grain dryer and produced a design concept for its manufacture. DRI assisted ICAITI in exploring possible sources of finance for the project, and DRI personnel arranged for visits and accompanied ICAITI staff on fund-raising efforts.

The Korea Institute of Science and Technology submitted a proposal for producing a composite flour that would substitute quantities of home-grown barley for imported wheat, if technical difficulties and consumer taste preferences could be accommodated. The DRI grant provided the full cost of this R&D effort, which resulted in the development of a product that not only met the consumer preference requirements, but also was compatible with the commercial bakeries' production equipment and methods.

DRI also funded a grant to the Ceylon Institute of Scientific and Industrial Research for an extensive study tour to the United States and the United Kingdom by one of the CISIR's senior scientists. The objective was to develop a program for producing food coloring, used widely in the dishes prepared in Sri Lankan homes and restaurants, that would utilize indigenous plants rather than imported coloring agents. The CISIR scientist visited experts in the food colors field and contacted commercial import firms that might wish to handle such products. This staff member subsequently accepted an appointment elsewhere, and to partially compensate for this loss, DRI provided an expert in the food coloring field, on-site in Colombo, where he advised on the technological and commercial aspects of the project and helped to prepare a proposal for completing the experimental program.

Under a DRI grant to the Institute of Mining and Metallurgy, Oruro, Bolivia, two mining engineers from that organization visited the United States under a special program arranged by a minerals consulting firm. Their purpose was to make laboratory studies of new chemical and magnetic beneficiation methods and to study mine waste water handling systems. Currently, plans are underway for tests to be conducted in the United Kingdom on a bench-scale high gradient cryogenic magnetic separator, which should help to achieve higher tin ore separation. It is also proposed to prepare special polymeric materials to act as "carriers" for various reagents used in the selective flocculation process of separating tin ore from its unwanted associated materials. Of special interest in each instance was the willingness of a U.S. consulting firm to undertake a joint venture with the IIMM.

The general conclusion from the research grants program is that the research institute in the developing country--when appropriately organized, equipped, and related to other elements of the economic development process requiring the application of technology--can be an invaluable link in the chain of development efforts. Further, the attainment of these precedent conditions is both feasible and desirable.

Specific conclusions are as follows:

- Time delays and communications difficulties exceeded expectations and hampered progress in technology identification, acquisition, and application. With the gaining of experience by those concerned, and with improved communications, it is anticipated that these problems can be significantly ameliorated, although underlying cultural factors that contribute to these problems may not be expected to yield so rapidly to change.

- Many institutions face problems and restrictions in gaining proficiency in the conceptualization and development of adequate research proposals.
- There is a lack of sensitivity to the techno-economic aspects of R&D projects, stemming perhaps from the lack of training in these aspects on the part of most institution staff members, who have been trained rather dogmatically in "hard science" subjects.
- Rapport with the user community is frequently underdeveloped and reflects a customary absence of direct industrial experience on the part of professional staff members, or a lack of training and emphasis on this relationship.
- In too many instances, facilities are lacking or inadequate to carry out R&D effectively. Gaining access to information is a concomitant difficulty.
- Most staff members are formally trained as scientists rather than as engineers, and a consequent shortage of persons with these technology application skill exists. Industry demand for engineers is characteristically so great that retaining persons with these skills in the institution is difficult.
- Most potential users of institute R&D services view ARIs as high risk ventures. They may feel that public-supported institutions should provide services at no charge. Their understanding of the nature and utility of R&D is often poorly developed.
- In DRI's experience, the ratio of results has been within what reasonably might be expected in terms of successes versus failures.
- The research institute is an important element in technology utilization, and its performance in this regard is susceptible to significant improvement in most instances.

The experience gained from the research grants program, coupled with the lessons learned in carrying out the OST-sponsored program, should be utilized to elaborate the experimental program. A structured approach that would include the missing elements in the technology application process should be employed. Such elements would include:

- training as needed for all those associated with the technology application endeavor;
- performance of feasibility studies and surveys for determining technology needs and approaches in specific instances;
- specific technological support and consultation on both the natural and social sciences as required;
- provision of facilities and equipment (especially pilot plant and demonstration units) and access to needed information to carry out R&D programs;
- mechanisms and means for forming effective links to user communities, investment sources, and government entities;
- assistance in organization, management, and marketing functions and in identifying entrepreneurs and assisting them in making successful technological innovations.

DISCUSSION

MS. LUCAS: I believe you stated that one of the criteria for giving a grant was to encourage better relations with the user community. It seemed that there were several points in this process where the user community could be brought into a project, and I wondered whether or not this was done. For example, a potential user could state if a project would be useful or valuable, and a cost-sharing clause could even be incorporated into the grant. Also, the user community could serve as a reviewer of the proposals. I wondered how the user was accounted for in this process.

MR. EVANS: That is a good question, and here are several quick examples. In the case of the extrusion cooker project with IIT, staff members were in contact with an equipment manufacturer in Colombia even before the proposal was written. This manufacturer subsequently agreed to fund up to 25 percent of the cost of the research, and this became one of the persuasive conditions of the proposal--that interest had already been lined up. This type of situation also happened in Korea with the composite flour project, and it happened in Honduras. We made a call on the government-sponsored agricultural cooperative, which said, "Yes, if you come up with something, we'll help test it, we will help distribute it, we will provide funding and credit for small farmers to buy the drier." That, in fact, was a condition. In the case of the food coloring project in Sri Lanka, the representative visited manufacturers in the United States, who said, "Yes, we'll buy your red color if we can get it past the FDA." Market studies of a conjectural nature like that were very important.

MR. KITCHELL: What was the average size of these grants?

MR. EVANS: The average actually does not convey much, but it was around twenty-five or thirty thousand dollars.

MS. LUCAS: What was the range?

MR. EVANS: I think that the most put out was forty-eight thousand dollars, the least around eight or nine thousand.

MS. ACHMAD: I would like to relate the feasibility studies to the user community contacts. In the case of Thailand, for example, the kind of product being utilized will substitute for imports. How does the feasibility study account for problems in policy change? For example, the user of the product will be pleased, but what about the importers? Also, you need to go to the government or to those setting quality standards in making the decision. How much contact did you have with those who establish the quality standards?

MR. EVANS: I think that this is an immense issue. Dr. Ayala asked yesterday about the definition of appropriate technology, remarking that it depends on the particular circumstances. The answer to your question is that I do not think a very profound analysis was made in any of these cases. It was a first-order determination, meaning, is there a customer for it? Nobody stood back and made a very sophisticated assessment of

the impact of the technology. I understand your question. I think that it needs to be addressed. But in these cases, referring to policymakers or to a national development policy was probably not part of the program.

MR. KITCHELL: Commercialization of the product was enough, wasn't it?

MR. EVANS: That is part of the question. Is that the only test that needs to be met? I am not sure.

MS. ACHMAD: Probably in the case of Thailand, the amount is not very great, so it does not have a large impact on policymaking. But in other cases, particularly in import substitution, it could have a much greater impact.

MR. EVANS: Very definitely.

DR. SMITH: It is the government's policy already that we try to produce import substitutes. So this is not really against the national policy.

MS. ACHMAD: But it will affect the people in the company that is now importing.

DR. SMITH: Normally it would be the same people the same company.

MS. ACHMAD: That is my point. Do you make sure that the same company will be thinking up the results as those who are now importing? And with these companies, is there any indication that they will make more money from import substitution, and if they do not, will they prevent policy from developing import substitution?

MR. EVANS: Ms. Achmad is talking about something that is perhaps more profound than appears on the surface. Sri Lanka has done a complete turnaround in its policy toward import substitution. Under the Bandaranaike socialist regime, everything was to be made in Sri Lanka, and hundreds of small-village industries developed. Now, with the change in administration, a complete reversal has occurred, and many of the domestic businesses cannot compete with imports. It is this kind of macroeconomic impact that cries out for a governmental policy and a careful analysis of the kinds of products you are going to produce, where you are going to invest your capital, and the kind of labor intensity that will be pursued.

[This concludes the discussion accompanying the presentation on Research Grants.]

LINKAGE MECHANISMS

James P. Blackledge
29 November 1979

(Present as guests were two representatives from the State Economic Commission Delegation of the People's Republic of China: Sun Shang-ging, Deputy Chief, Research Institute of Economics of the Chinese Academy of Social Sciences; and Lo Kai-Fu, Official of the Liaison Office of the People's Republic of China in the United States, acting as interpreter.)

One of the goals of the six-and-one-half-year experiment to strengthen S&T institutes in developing countries was to create linkages between institutes in industrialized and developing nations. Objectives of this linkage program included the following:

- institution building;
- staff training and development;
- enhancing or augmenting scarce human resources, particularly in the developing country institutes;
- sharing of facilities and equipment;
- providing an opportunity to identify national or industrial priorities and needs;
- the bringing of expertise to the linked institutes vis-à-vis consultants and experts in specialized fields; and
- developing joint or cooperative ventures in R&D.

The first type of linkage is that between institutes in developed countries and those of developing nations. A second type is that between two developing country institutions. The linkages between IIT in Colombia and the PCSIR in Pakistan and/or TISTR and IIT are examples of this type of relationship. Certain advantages are inherent in these linkages. First, these institutions exist at approximately the same level of organizational and technological development. In other words, the technological gap between two such institutions is narrower than is the case between institutes in the developed and developing nations. If these linkages are established between institutions in the same region, smaller cultural differences will be evident, which means that in many cases, it will be easier and more effective to operate and develop linkages rapidly.

Either type of linkage poses problems, or constraints, which many include the following:

- The developed country institute brings the latest but not always the most appropriate technology, training, or expertise to the linked developing countries.
- A considerable amount of time is sometimes required for an institution in a developed country to understand the nature of the needs and problems of the institute in the developing country.

- Governmental or political constraints occur, particularly in the case of institutions that are under governmental ministries or that are principally administered by the government. An example is the linkage between DRI and the PCSIR in Pakistan, which required almost two years for completion of the agreement. During that two-year interim, a mechanism was discovered whereby DRI and the PCSIR could work together in the absence of a formal agreement signed by the government of Pakistan, but this was a constraint because the PCSIR had certain limitations on what it could do. Constraints were fewer because of the capability of the PCSIR management to circumvent governmental regulations. Nevertheless, such regulations can cause delay in implementation. On the other hand, with an institution such as IIT, the only approval that is required comes from the Board of Directors. This was also the case of TISTR with their Board. When institutions are more autonomous, it is much easier to establish the linkage mechanism.
- Financial considerations can be a constraint. Transportation costs, staff salaries, equipment use fees, and facility costs all must be considered when a linkage is being developed. Otherwise, the linkage exists in theory and name only, and it will not be productive.
- Technical and managerial levels of competence and interest can be problems. If the management of the institutions has no interest in the linkage, and if the technical staff does not perceive opportunities through the linkage, then this becomes a very real constraint that can cause the linkage to fail.

What are the advantages to be gained from linkages? First, the institution in the developing country gains prestige if it can say that it has a linkage with an institution in another country. Also, the linkage creates a certain amount of confidence on the part of the staff within the linked institutes in the developing countries to undertake research projects for industry or government. Staff members recognize the fact that they have backstopping expertise, advice, counsel, and guidance available from their linked institute.

A linkage can occasionally give an institute the opportunity to bypass governmental constraints. Sometimes small items like an electronic component or two ounces of a chemical reagent can cause a whole research project to collapse because of the time involved in going through the bureaucratic process.

The DRI program has several examples that can be regarded as leverages, and these are the opportunities to acquaint governmental leaders with the potential for applied R&D. Certainly this has happened in Thailand and in Pakistan. The Pakistan Minister of State for Science and Technology actually visited DRI last year, and DRI staff subsequently met with him and his staff in Islamabad in February 1979. There have been frequent meetings between TISTR and the ministries of the Thailand government to explain what is happening through this linkage mechanism.

The potential for conducting joint R&D projects is also considerable. The village-level food-processing project in Pakistan, the sugar project in Colombia, and the integrated rural development program in Thailand are examples of joint undertakings between institutions.

Linkage agreements can be categorized into three types: a memorandum of understanding, an informal linkage agreement, and a specific contract. The memorandum of understanding can be specific or general. As an example, such an agreement could limit the linkage to staff development and training activities, or to a specific type of research in metallurgy. A memorandum of understanding should state very clearly what is expected and what is to be provided by both parties. This type of linkage agreement was established between TISTR and DRI and between the National Research Center of Egypt and DRI.

Informal linkages require no written agreements. DRI has enjoyed such an informal agreement with ICAITI in Guatemala for the past twelve years. It has been found to be expedient to work together from time to time as problems or needs arose. Although this type of linkage has been successful in this instance, it is not recommended as a general case.

The third type of agreement concerns contracts. The contract between IPT in São Paulo and DRI was funded by the state of São Paulo, with a USAID loan, but the monies came from IPT to DRI for technical assistance in specific fields such as packaging, metallurgy, quality control, equipment acquisition, railroad technology, and other areas. DRI currently has a contract with the National Research Center in Egypt. A proviso in the agreement states that every effort will be made to work together but that the contract is contingent upon the availability of funds from USAID. The contract between the National Academy of Sciences of the United States and DRI is the funding mechanism that makes it possible for this linkage to function at the present time.

The linkage mechanism also seems to be a viable option for developing countries to participate in the TCDC, or the Technical Cooperation between Developing Countries, program. It is a mechanism for institutions to work together and to exchange technical know-how through networking. This is an important area that hopefully will receive considerable emphasis on the part of the U.S. government, the United Nations systems, and other funding organizations.

As a final comment, a question seems appropriate. Should a linkage be involved in policy considerations, or should it restrict itself solely to technical considerations?

DISCUSSION

MR. KITCHELL: Do you use the term "linkage" when you are referring to two institutions and the term "networking" when you are referring to more than two?

MR. BLACKLEDGE: That is correct. There can be a network of linkages or a network of institutions.

MS. LUCAS: I am interested in the question posed to the group about the nature of linkages. I would like to hear Mr. Blackledge's perspective on working with these organizations.

MR. BLACKLEDGE: A number of discussions over the past several years have focused on how to influence the decision-makers in a country, be they governmental leaders or industrial leaders. It has been questioned whether or not institutions such as DRI should be involved in face-to-face discussions with leaders at these levels about the role of their indigenous research institutes in problem solving, country policies, and other issues. In some circumstances, this might not be welcomed by the host country's government or by the industrial leaders. In fact, it might create more of a problem for the indigenous institution. In that situation, an institute should never be involved with politics or governmental policies of that country or attempt to change cultural considerations. One example of this is population control, which is a very sensitive subject in some countries. But should we consider only linkages between technological institutes at the technological level? Maybe another kind of twinning or linkage arrangement, such as between academies of science, should be considered.

MS. LUCAS: This problem is being discussed in our own country. It seems to me that technological or scientific organizations are particularly capable of commenting on certain subjects in their field of expertise, but that they have no more right to be heard on subjects of policy-making and resource allocation than other organizations. If, for example, the technical institute gets involved in a policy discussion, the U.S. technical institute may be considered to be speaking for the United States, which is normally the domain of the Department of State. Also the technical institute may add more weight to the technical considerations or the opinions of the technical institute.

MR. MOELLER: I like that statement in that it was provocative. I am not so sure that I agree with it. I am going to use the U.S. government as an example to show why this relationship may not always be so good.

It is, as best I can determine from within the State Department, the policy of the U.S. government to be essentially neutral with respect to the transfer of technology out of or into the United States, and I have discussed this policy in great detail with those who have formulated and operate it. Having been affected by these policies because of my role in international technology transfer, I can say categorically that in any single project, the policies of the United States are not neutral. In some cases they are positive and in others they are negative, but I know of no case where they are neutral. The State Department is astounded by this fact, and argues the point vehemently.

I would submit to you that it is one of those subtle facts of which only the people who work in technology transfer are aware enough to make the case. Academic institutions, by and large, are not capable of this. The people who are affected by policies have a somewhat special position in the sense of having an input into the formulation.

MS. LUCAS: The point I am trying to make is that when we talk about a technical institute, these are not the only people who are affected by these policies, and their considerations and problems should not be given any more weight than, for example, those of the consumers and the general population. What I was talking about is a linkage institution from the United States becoming involved in policy discussions within the host country.

MR. KITCHELL: What do you mean by policy?

MS. LUCAS: If you consider, for example, financial policy and whether or not you are going to allow particular types of technology into the country--such policies may have a technical component associated with them, but they have broader economic implications. One should not give the technical considerations undue weight over other considerations.

MR. KITCHELL: In theory you are absolutely correct, but in practice it is a moot question. In the first place, most of these countries do not even have a science and technology policy that can be related to any specific allocation of resources or specific priorities. And if they do, with a few exceptions, it is more rhetorical and more on the surface than it is real. Obviously, no U.S. institution is going to go there and get involved in those areas. On the other hand, if you are trying to influence an IRSI to be responsive to the needs of industry, which we should be doing, you are indirectly forcing the IRSI to react with other people in the home environment, to take a policy view as to how industry should be growing, which industry should be getting assistance, what type of assistance it should be receiving, and so on.

Dealing with a university is in some ways similar to dealing with developing countries; that is, you cannot always get your fingers on the problems. You can go through innumerable contract processes, stipulating what will be done and how much money will or will not be spent, but none of it will be successful with the university unless there is enough overlap between the objectives of the university or the faculty and the other party involved. I suggest that the same situation occurs with these linkages. If there is a sufficient overlap of mutual interest between the IRSI and DRI, then you have established some scope for an effective linkage. If the relationship is just peripheral interaction, it will not be sustainable.

MR. BLACKLEDGE: One of the policies of the Pakistani government, as I understand it, is to emphasize minerals exploration and development. That policy was not determined, I am sure, by the PCSIR, although I am quite confident that PCSIR had inputs into that policy determination. Through the linkage between PCSIR and DRI, expertise was brought to bear, consultants were sent to the country, and a mechanism was provided for a conference or workshop, which brought together governmental leaders, technical people, and others. Dr. Ghani, did these people have an impact on the policy evolution of the Pakistani government? This might be one way in which a linkage impacts on the policy considerations of the country.

DR. GHANI: Pakistan had a five-year economic plan that stipulated which minerals needed to be developed. After that plan terminated, various groups got together, including the PCSIR, and decided what the priorities should be for the next five-year plan. Once this had been accomplished, we had to determine the role of the PCSIR in that plan. With that objective, the seminar was conducted. I think that is the only way you can work with it. When the plan has been formulated, then through the linkages we can guide the government--we can tell the government where the PCSIR can have the maximum impact regarding resources and manpower, equipment, and so on. Once that policy is formulated, then we can work together.

DR. AYALA: I would like to clarify the idea of the linkage mechanism. If we consider past experience, the linkage mechanism, at least in the way in which IIT and DRI have worked, is good. We need to continue with the mechanism, to try to improve it. We need to examine the possibility of extending the use of the mechanism for our own activities and interests.

Regarding the levels of action, specifically the policy level, we must use the experience of the mechanism. At the policy level, the local institution must have total responsibility in order to decide according to its own conditions. I prefer approaching policy indirectly. An institute such as IIT must first know the governmental policies in order to determine technological activities. Decisions are not made alone or internally--the institute must consider future external conditions.

The government is now facing the worldwide energy problem and supports the use of alcohol as an additive to gasoline. This is at the policy level. A special governmental committee has been organized to prepare a program for these developments, and the government has invited IIT to participate. In this way, IIT will be involved at the policy level.

Brazil is the leading country in using this technology, and IIT hopes to develop more of a relationship with that nation. We feel that the types of activities that we pursue in this regard must be determined by the local institute according to its own situation and that of the country. We as directors of technological institutes are trying to understand not only the technological institutes, but also the economic, social, and political situation of our country. Probably we need to develop a new type of person--the polytechnical person.

DR. SMITH: I think that policy planning should be done by the nation itself. For example, in Thailand we have a national policy for economic and social development. It is a five-year plan. Our institute must follow the national policy in conducting any research work. Our linkages would focus on a strategy that would help to achieve the goals or policy already established by the government. For example, governmental policy is to concentrate more on rural development. Therefore, it is our duty to set up a strategy to achieve such policy.

INTERPRETER LO KAI-FU FOR MR. SUN SHANG-GING: The China Enterprise Management Association is interested in these subjects. Linkages between our Association and others in the world would be conducted according to our modernization plan, and at the moment we are quite interested in training programs for our management people. We also have institutes of science and technology that wish to establish linkages with U.S. institutes.

MS. ACHMAD: I would like to comment on whether the linkage should be focused on the technical level or policy level. I think that you should not focus on one but on whatever is needed. On policy, I would say yes and no; no in that no foreign institution, government, or organization should try to influence other people. But there is a need to develop a method to formulate policy, and this is needed in developing countries. Therefore, I would expect that any linkage, especially between developed and developing nations, should enable the counterpart institution to see the main elements that should be considered in formulating a policy. And policy, of course, can be at many levels.

One level is exemplified by the research institution. How does such an institution formulate policy? I would like to see institutes in developing countries have the opportunity to see how policies in U.S. institutions are formulated. But this opportunity should not be limited to U.S. policy formulation--it should also encompass ideas from China, the Soviet Union, and other countries. If institutions could be helped to see their function in the formulation of national policy, as has been expressed by the three institute directors here, institutions could play their proper roles in national policy formulation.

MR. KITCHELL: It could be stated even more simply--to develop and implement policy requires information. To the extent that the information required is technological in nature, hopefully the technological institutions in the country will be involved. To the extent that they need linkages to help develop this information, linkages have a role to play.

MR. MOELLER: Not only technological, but to a degree, methodological.

DR. BLACK: I think that the type of linkage depends upon the needs of the institute and the country in which the research institute of an industrialized nation is working. These needs change and evolve as both the country and institution grow. In the early days of TISTR, particularly when UNIDO was working with TISTR, much of the effort that was provided the institute through linkages with CISRO and other organizations was technological in nature. Much of it had to do with training people in technical fields and with furnishing equipment.

As TISTR grew, and as the Thai economy developed to the point that it could begin to use more effectively the services of a research institute, considerations of how this technical capability could be linked with the needs of the country began to take on a greater urgency than in the earlier institutional building phase. As a result of that, our linkage has focused more on aspects of management. We have also supported TISTR in technical areas, but the emphasis was on management.

When it is needed, a linkage between a developing country institute and an industrialized country institute can, also, be appropriately used in the area of policy. It is not as if an organization, such as DRI, is trying to change the policy of a developing country, but at times it is inevitable that policy is affected, whether it be within the institute or how the institute functions within the economy, or even policy within the country.

For example, when ICAITI wished to become more self-supporting, the institute asked for assistance. Mr. Blackledge influenced them to shift their internal accounting policy so that they could be more responsive to their clients by explaining where the money went and why it cost what it cost. This affected internal institute fiscal policy.

In Indonesia, DRI has been working with LIPI in the area of management development. Subsequently, a policy has developed that management training will be institutionalized in Indonesia, and this is an important aspect in the development of science and technology within the country. In some ways we affected that policy through our work with LIPI.

In Thailand, TISTR recognized the need for the institute to have more influence in technological aspects of the policymaking process. On numerous occasions, we accompanied people from TISTR to the National Economic and Social Development Board and talked with the secretary-general of that board concerning how an organization like TISTR could provide valid input into national policymaking as it affects science and technology. Although DRI may not have directly influenced policy, during the period of our linkage, TISTR has been called upon more often to make inputs into the policymaking process.

Hence, there are many ways that a linked institute can assist an organization in a developing country. It may be by giving technological training, technical assistance, or management training, or it may affect policy. The word "undue" was used by Ms. Lucas to describe policy intrusion. No linked institute should provide undue anything. Assistance should be appropriate to the circumstances.

One of the mechanisms that allowed us to interact effectively with our three linked institutes was the flexibility that AID allowed us. We did not have to define every program and project six and one-half years in advance. As IIT developed a need, they could come to us and we could respond swiftly. If TISTR needed technical support on a contract project that they had just been awarded, DRI could provide immediate assistance. If we had had to program that project six months in advance, it would have been impossible. Therefore, the flexibility that AID has given us within this experiment has been very important in our ability to be beneficial to our linked institutes.

[This concludes the discussion accompanying the presentation on Linkage Mechanisms.]

SECOND-GENERATION LINKAGES

Ronald Black
29 November 1979

The needs of an institute change along with the economy and environment in which the institute functions. Many past linkages were aimed largely at strengthening capabilities within the institutes, and at least two approaches were used. The first was where two organizations had a mutual research interest and were conducting research in the same area, sharing information, and possibly sharing equipment. The second approach was for international organizations or industrialized countries to support technical assistance programs in attempts to increase the capabilities of research institutes in developing countries via a linkage mechanism.

However, as the capabilities of developing country institutes increase and institutes become better able to effectively shape their own destiny, another type of linkage or network will become increasingly influential. It is based on the philosophy that there has to be a mutual financial advantage for the concerned institutions for a linkage to exist and be active. This type of linkage is what I call a "second-generation linkage." It is one in which the philosophical basis is to increase contractual income on the part of those concerned. In other words, it is a linkage based on a financial motive and involves establishing joint ventures between institutions.

Dr. Ghani of the PCSIR noted that in the future he would like the DRI-PCSIR linkage to move toward cooperative projects, or joint ventures. In 1976, USAID-Pakistan provided the Appropriate Technology Development Organization approximately \$600,000 for contracting with a U.S. or Pakistani organization to identify, develop, produce, and disseminate, on a pilot project basis, appropriate technology of a suitable scale and sophistication for use in farm and village-level processing of sugarcane, oilseeds, and rice bran. In response to a request for proposals, PCSIR and DRI formed a joint venture, submitted a proposal, and subsequently won a contract to do the work. The project is currently in its third year.

DRI has also submitted a number of joint proposals with TISTR. A recent submission was a joint proposal to the tourist organization of Thailand for conducting a market analysis of the tourism potential in an area of northern Thailand. The contract subsequently was won. During negotiations, DRI's role was eliminated from the program, but this does not negate the fact that a joint venture was formed and a project was obtained.

A new linkage has just recently been established between DRI and the National Research Center (NRC) in Egypt. The explicit purpose of the linkage is to combine resources for conducting projects in Egypt and other parts of the Middle East. Capabilities and resources will be shared to mutual advantage, but the primary incentive is financial. Early this year, DRI and the NRC responded to a request for qualifications to provide industrial sector training aimed at enhancing the

capability of public sector firms and the General Organization for Industrialization (GOFI) in allocating resources, efficiently assessing prospective investment projects, and helping to implement production plans. The DRI-NRC joint venture was chosen as a finalist and has a good chance of winning.

An even more ambitious form of second-generation linkage has been discussed within the ASEAN countries since 1974. This is a concept for a network of contract research institutes. A number of attempts have been made by ASEAN institutes to initiate joint ventures, and one of the most interesting was a response that was made to a request for proposals by the Thai Board of Investment to conduct feasibility studies in agro-industry.

TISTR felt that to qualify for the program, it needed backup support in the area of leather technology, and the Indonesian Leather Research Institute was asked to provide the technical capability. Palm oil technology also required a technical component, so TISTR went to the Standards and Industrial Research Institute of Malaysia. DRI was asked to support TISTR in a couple of other areas of expertise that were not available among institutes in the network. So essentially a network proposal was submitted. About twenty organizations or joint ventures bid on this contract. As noted earlier, TISTR did not win the contract, but it did get into the runoff. The other organizations that got into the final round were all U.S. organizations, and the proposal that won the contract was a joint venture between two top U.S. organizations. The lesson is, if organizations such as TISTR, the Leather Research Institute in Indonesia, and the Standards and Industrial Research Institute of Malaysia combine their capabilities and augment them where necessary with outside resources, they can put forth credible ventures that can compete in the international contract research arena.

During the evolution of the thoughts behind this network in Southeast Asia, much discussion has taken place about whether the network should be limited to a few areas of interest to all of the network institutes and the network attempt to market largely in these areas, or should network institutes be encouraged to market network projects in all areas in which a network institute has capability. In either case, participation would be voluntary and based on mutual financial advantage. For example, if TISTR saw a project that it wanted to bid on, certainly it would initially use its own capabilities. If it was lacking some element or expertise, then it could search within the network. The network would operate on the underlying philosophical basis that it would be a financial motivation that would bring the institutes together. It would be a business.

DISCUSSION

MR. KITCHELL: Most of the problems with the research institutes with which I have come in contact concern selling their services in their own country. Is it a proper priority for outsiders to be encouraging them to enter into arrangements to sell their services on an international basis before meeting the needs of their own countries?

DR. BLACK: That question has been asked on a number of levels with respect to this ASEAN concept, and it is certainly valid. To address it, the rationale and objectives of the network must be considered.

I think that the ASEAN institute directors and management have the impression that projects done on contractual bases have more interest for their staff. Staff members seem to be more motivated, they do better work, and they do it in a more businesslike manner. And directors have been trying to develop this type of environment within their institutes. Therefore, they have been attempting to get increasingly more of their projects to run on this basis. Also, they feel that they can learn more from a joint venture.

The primary objective of the network was to strengthen national institutes. The network is viewed as a mechanism for doing this partially as a result of the factors just mentioned. Assuming this is achieved, then stronger institutes can more effectively meet needs within their own countries.

A secondary consideration, however, was that perhaps ASEAN would become interested enough in its economic and political union that it would like to maintain the network, but that was not the primary purpose of the network. It was a mechanism to strengthen national institutions.

MR. MOELLER: I think that each instance has to be viewed in relation to the circumstances. If an institute wishes to respond to an international opportunity outside the country and decides that the expenditure of its resources is in keeping with the possible monetary net gain, then the institute should be free to do so. I would hope that AID would not try to put any constraints upon them in this regard. On the other hand, though, there is the danger that an institute may decide to take what I would call a "modified ego trip" and begin expanding resources to achieve international goals in order to enhance its prestige. But here again, it is a judgment.

MR. KITCHELL: Being very practical, I think that UNIDO may be sponsoring the next meeting of this group, and the objective ought to be clarified. I am not supporting one view or the other. Obviously, there can be many tactical advantages for doing an international project, including increasing prestige, which is always an important element. But we never want to lose sight of the basic purpose of these institutions--to increase industrial development in their own nations.

MR. MOELLER: In the best possible manner with the widest possible resources.

MS. FLYNN: Mr. Kitchell, your question reminds me of one asked at AID. Do we serve the Congressional appropriations committee or the needs of the developing countries that we are supposed to serve? I would like to think that there is an overlap area, that there are times when institutes are serving both purposes--meeting their countries' development goals and doing that by playing in the international arena. I do not think that it has to be an either/or conflict.

MR. BLACKLEDGE: You have to define what you mean by entering into the international marketplace. If you do work for General Motors in the United States (this is a ridiculous example), that is one set of circumstances. But if you are able to obtain funding from the World Bank or the InterAmerican Development Bank to develop an alternative energy project in Central America or a fertilizer center in Brazil that contributes to the country's development, then I do not see any problem. I would certainly agree that if TISTR, IIT, PCSIR, or any of the other institutes tried to compete with a European or U.S. institution, that would be a different situation.

MR. KITCHELL: The final deciding point is the quality, the quantity, and the significance of the services that the institute is providing to the clientele in its country.

DR. BLACK: As was just stated, the situations are variable. Yes, the ARIs are competing with U.S. organizations. For example, TISTR was competing with U.S. organizations with its proposal for the BOI project in Thailand. Every organization in the final runoff, except TISTR, was from the United States. As it turned out, a U.S. joint venture did the project in Thailand. The U.S. organizations learned what industries are feasible in Thailand and took that knowledge and the increased capabilities they gained through doing the project back to the United States. Yes, we were trying to get TISTR into a position to compete against those U.S. organizations, and I think they made a good showing.

We are now doing the same thing with an Egyptian organization in proposing to put on a training program for their state enterprises in Egypt. We think it would be good if our joint venture won that project, not just from our standpoint, but from the standpoint of Egypt. The Egyptian organization would build its stature and gain an understanding of how to do this sort of project. When the program terminated, the knowledge would reside in each institute, not just in DRI. So yes, we are trying to compete with U.S. organizations.

MR. MOELLER: This discussion is becoming very theoretical. Let us assume that the manager or director of an institute is competent. By saying that, you are acknowledging the fact that he is competent in marshalling his resources to meet his obligations, in which case, "we have no business interfering." It is his business.

DR. BLACK: If it is against Thailand's policy to work in a particular area, TISTR would just say "no."

MR. BLACKLEDGE: KIST is the prime example of an institution that has gone outside its own boundaries and secured contracts in Southeast Asia. This is correct, is it not? They reached a level of sophistication and competence where they felt comfortable competing in that marketplace.

DR. BLACK: So does ICAITI.

MR. KITCHELL: Well, there is a balance that has to be considered.

MR. MOELLER: But who makes the decision on the balance?

MR. KITCHELL: The institutes have to make it themselves.

MS. ACHMAD: This is only true, though, for a nongovernmental research institute. In Indonesia, most of the decisions are made by the government. You cannot just decide that you are going to do a project. You have to get the permission of the government, which will ask what percentage of your resources will be used, and what are the advantages. It is a governmental decision to allow it or not. In the case of TISTR, of course, and IIT, they are corporations, so they actually do business. Therefore, it is the management of the corporation that will decide.

MR. KITCHELL: Most corporations are government organizations, too. Very few IRSIs get any considerable amount of money on a continuing basis from industrial sources.

MS. ACHMAD: They have more flexibility to decide.

MR. KITCHELL: Sometimes they have the flexibility and do not use it.

MS. ACHMAD: In Thailand, the board decides, not the government. In our case, it will be the government. We cannot join any international activity without former approval, and you must first indicate the percentage of your resources that will be used and the advantages for the institute or the country. But in a corporation, it is the management that decides.

MR. MOELLER: It is also a question of time. For instance, you may take on a particular job, national or international, because you realize that in five to ten years, the experience from the project will be useful to your country. Right now, however, no one sees it at all, and in a political process they certainly would not see it.

This I consider to be excellent management. It is management that sees beyond today and tomorrow and beyond next year and begins to work toward building resources for that future time. This is one of the great limitations of much of the political process.

I find myself caught on the horns of a dilemma. We say that it would enhance the ability of ARIs to serve their country if they were to serve industry on a contract basis and obtain more of their support from that sector. But if we now propose policies predicated upon their present support from the government, we are raising barriers. We must recognize that ARIs get support from the government, and, at the same time, propose policies more in keeping with support from industry. If this is not done, if the ARIs must conform to policies that relate to the strong support from government, then we are closing the door on their ability to get contract support from industry.

MR. KITCHELL: The problem is that most institutes are at the extreme of this problem. An institute can get its guidance from two sources. It can get it from the government, and in our sample, most of the institutes were 50 to 95 percent supported by government. Even in the

ones that were joint institutes with government and industry, government was always the major supplier of funds in one way or another. If the government, being the major sponsor, also has a technology policy, that is not such a great difficulty. Then the problem is the mix between general subsidies and directed work for governmental organizations. If industry is represented in the management of the board, or if industry is contributing to the support of the institute, then it obtains effective direction from that source and usually facilitates the institute's doing contract work with the industry. However, most of the situations are in-between. The ARIs are not getting definitive government guidance, either in the form of contracts for directed research or in the form of specific goals, nor are they establishing rapport with industry. Therefore, I am not sure that going outside of the country solves this problem.

DR. BLACK: It is not always a situation in which the organization goes outside--it is also one in which organizations come into the country.

MR. KITCHELL: That is a different point.

DR. BLACK: But they cannot be isolated. When TISTR bid on the project with the Board of Investment, organizations from Indonesia and Malaysia were to come in and help carry out the work in Thailand. The next time, maybe an Indonesian organization will invite TISTR to participate in a joint venture. If TISTR agreed, the work would be done in Indonesia that time.

MR. KITCHELL: But when you look at TISTR, no more than 5 percent of its work has been derived from direct contracts, and that is still the situation today.

DR. BLACK: But in 1974 it was at 2 percent, and over the last five years, the increase in volume of their contract research has been six to tenfold.

DR. AYALA: What amount of money does DRI, Stanford, or Battelle receive from the government and industry for contract research?

MR. MOELLER: I do not differentiate between government and industry. When you submit a proposal, you get support, whether it is from the government or from private industry. I do make the distinction, though, between contracts and what I call lump subsidies.

DR. AYALA: We probably need to compare likely second-generation linkages sources of income to other sources for the development of projects. One of the problems of selling our services is that the institute needs to anticipate the problems and work in areas that politicians do not realize are important. An example is the coal resources of Colombia. IIT began to think about this resource more than ten years ago, before the oil embargo. At that time, to get a small subsidy for starting the work in coal, we approached the government and one of our sponsors, the Colombia Petroleum Company. They replied that Colombian coal was deep underground and that oil was the main concern. In any case, we persisted, and now we have a small laboratory. Most of

the effort for this project did not come from local financial assistance. Some people outside understand better about future development. The government now has more interest in the development of coal resources. This is why we need to plan for the future. In this way, a second-generation linkage could help IIT's future development.

DR. GHANI: Both the general public and the governments in developing countries have a strong impression that all the national R&D organizations in developing countries have proved ineffective and unproductive. It is being debated, especially in India and Pakistan, whether the scientists' contribution in these research organizations has been negative from an economic point of view. But if the research organizations have failed, what is the solution? And at the political level, it is being thought that if the institutes have failed to produce more than what has been put into them, then either they should be completely eliminated or strengthened. So the scientific community is trying to tell the government that science and technology holds the only solution for development in developing countries. If the scientific organizations have failed to have an economic impact and you want to eliminate them, another possibility is to give the contract to an institute that can do the job even if this is an institute from another country. This is the debate in Pakistan even at the political level.

Governments in developing countries are currently drawing up five-year economic plans and are getting loans and aid from international organizations. These loans and aid are to be used for certain projects, and these projects are usually given to multinational corporations in collaboration with certain private parties in the developing countries. We in scientific organizations can play the role of those private parties, because if private industries are getting the contracts and making money but have no scientific base, why not give that role to the national scientific organizations? It is here where second-generation linkages can be important and play a positive role. This could work very well. Slowly, science and technology would develop people's confidence in the scientific community of their country and of other developing countries.

The R&D organizations in developing countries are so small, and their inputs are so small, that they cannot have major breakthroughs, which means that their direct contribution to industry is going to be small. They can provide assistance to industry for repair and maintenance and give general advice on improving efficiency, but I do not think that it will be possible for them to help bring in new technologies and factories for some time to come. So the impact we can have is to work on certain projects in which we can collaborate with international organizations. Perhaps that will give some confidence to the government.

DR. SMITH: I think that the basic problem of the newly formed research institute is the comparability of reputations. This is extremely difficult. First of all, we have to build up the equipment and the personnel, and also build up accomplishments. This takes time and effort. In the last three or four years, our reputation has become increasingly better, both with the government and with private enterprise.

The idea that networks should play more of a role in development arose a couple of years ago. In many fields we do not yet have the necessary expertise, but this is where expertise from neighboring countries can become important. This is the purpose of the network--to employ the knowledge of another country that has more or less the same working conditions, the same economic situation, and the same capability.

The usefulness of our participation in projects in our own country is that we understand the local conditions. Therefore, when problems arise, we can cope with them. So I think that we agree with the network spirit.

DR. AYALA: I would like to give an additional comment about the idea of networks of regional institutes. It is important to recall our Andean group of five countries. We had to start with some type of project, and now we have regional programs. One is in the area of food and nutrition, another in copper resources, and we are discussing future programs in coal resources. The initial political decision was to start some type of economic integration between the five countries. Within this context we are trying to initiate action in the technology area. Second-generation linkages hold distinct possibilities for technological integration and cooperation among institutes in Andean countries.

MR. KITCHELL: I would like to read one of the recommendations that came out of the UNDP/UNIDO evaluation of ARIs that will be presented to our board in the spring. This recommendation was included in the report under improving the effectiveness of UNDP/UNIDO assistance to these agencies. That is, we should provide support and direction to WAITRO as a mechanism for (1) locating, arranging, and managing twinning agreements for institutional purposes; (2) identifying topics in IRSIs for cooperative research; (3) assisting in the exchange of staff, technical information, training materials, and so forth; and (4) creating a network of research institutes working on common problems of industrialization in developing countries.

The prospects of acting on this recommendation are greatly improved if one assumes that the U.N. fund on science and technology, recommended at the UNCSTD, will eventually be established and in sufficient magnitude. So it is more than an academic question at this moment, and I would like to get some reaction as to whether participants in this conference think that WAITRO has a role to perform--a larger role than it has been performing to date. And if it does, how should WAITRO be "reincarnated" to perform such a role?

MS. LUCAS: Why is WAITRO considered of value?

MR. KITCHELL: Who said it was of value?

MS. LUCAS: That is the implication.

MR. MOELLER: It just has not been a success.

MS. LUCAS: I am not familiar with it.

MR. KITCHELL: It stands for the World Association of Industrial and Technological Research Organizations. When it was established, it was based on a premise that I find unsound, which is that a voluntary organization supported by the dues of its members can accomplish a lot. I believe that it first found a home in the Industrial Research Institute in Vancouver, which provided staff to WAITRO. Currently it is with TNO.

MR. AYALA: You cannot say if it was a success because this depends on its resources. I cannot consider WAITRO a network because it is only an association of forty or fifty institutes.

MR. KITCHELL: The question is not whether it was a success or a failure. The question is whether it can be converted to serve at this third level.

DR. AYALA: Yes, as an association.

MR. KITCHELL: The feeling of the group in this evaluation report was that WAITRO could expand itself to perform the roles that are included in that recommendation.

MS. LUCAS: You are asking whether or not we should do something with WAITRO, and it has been recommended that something be done with it. That kind of attitude bothers me because it seems like the question to address is, what kind of linkages or networking currently seems to work among these organizations? We should build on those rather than suggest that because WAITRO is an organization, we should build it up to be the networking function. Why pour more resources into an organization that may or may not work? Why not strengthen what linkages are currently in existence?

MR. MOELLER: That is a good question, and I would like to answer it. On two separate occasions in two different forums, I have proposed putting a small amount of money into WAITRO for the specific purpose of attempting to make it useful in a more specific way. If WAITRO has been a failure, maybe we should start something new. But my perception is that it has not been a failure--it just has not been a success. So we still have the option of seeing if it can be built into a useful organization.

The question is whether such a broad association can be used efficiently and effectively. The central problem is whether or not all of the members have sufficient mutual methodologies and interests so that they can associate without any great wrenching on a case-by-case basis. For instance, as an analogy, in the United States there are trade associations between commercial entities that are in the same business. Trade associations in the United States traditionally serve three distinct functions. One is the acquisition and exchange of information that is essentially nonproprietary but nevertheless is extensive and from all sorts of sources. They also lobby the U.S. government in their own interests. And third, they perform R&D--a

function that most people do not recognize. They sponsor R&D of a nature generally interesting to the membership. The question is, could WAITRO provide these same kinds of functions? Could it lobby to influence policies in the United Nations? If it begins to lobby within the individual countries, it will be taking over a role of its members. So that function does not seem too viable. However, WAITRO may be useful in information dissemination. I am interested in knowing if WAITRO could provide the vehicle for the sponsorship, if you will, of the testing, of some research or development aspects of general interest to the institutes. WAITRO could provide the vehicle for working on methodologies for the forming of cooperative relationships and linkages. It could be the vehicle for sponsoring activities of general interest.

After having looked at this in no great depth, I think that the potential usefulness of WAITRO is at least worth exploring in greater detail. I am not sure that I would want to commit myself to the use of it.

MS. LUCAS: In an organization like WAITRO, you have certain set costs in setting up a new group. This concept of our government and of other governments to set up new organizations without looking at existing groups and functions that are being performed is madness. WAITRO is not a real, existing organization that is performing functions for groups that do R&D.

MR. MOELLER: You are losing sight of one thing. WAITRO has perhaps as many as seventy members who have agreed to ante up their own funds to form the organization. So at least this many have said that WAITRO might be useful. I find myself somewhat intimidated by numbers. On that basis alone, we have a responsibility to explore the possibility without committing ourselves.

MS. LUCAS: It makes more sense to me to look at how the functions mentioned in regard to trade associations are currently performed. They may even be performed by a formal group that requires an international administrative structure.

MR. MOELLER: That is exactly what I mean.

MS. LUCAS: If that is the case, and if you want to support these functions, you can put your money into operational rather than administrative costs.

MR. MOELLER: You and I are debating from two different suppositions. I based my proposal on the presumption that I am presently ignorant of the possibilities, and I want to find out what they are.

MS. LUCAS: I am ignorant of the possibilities, too, but I am not going to assume that we ought to start with the organization. Instead, we should start with the function.

DR. GHANI: Start from the grassroots, yes.

MR. BLACKLEDGE: I have been involved in WAITRO since the beginning. I have been a member of the executive committee for two terms--or six years. First, WAITRO has suffered from a lack of leadership, not because the people themselves were not qualified. The executive committee of WAITRO has had an opportunity to meet once a year for one or two days. The funding has also been very limited. The total budget has been about \$70,000. It has been augmented in part by UNIDO and to a considerable extent by CIDA, in Canada, through the efforts of Paul Trussel. But CIDA money was to be used for training programs. I think that the training function of WAITRO has been reasonably successful, but there has never been any money for people to develop programs. How can an executive committee meet once a year and develop a cohesive program that can be implemented when its members must go at their own expense and meet for only two days to debate the protocol, politics, and cultural differences of seventy different institutions?

MS. LUCAS: It indicates to me a lack of interest in participating.

MR. BLACKLEDGE: I have been fascinated by WAITRO since its beginning. If you were to ask me today, I would say that it is somewhat a failure. But it is due to a lack, not of the secretary-general leadership, but of the total leadership. The executive committee of WAITRO has not had the opportunity to function.

MR. KITCHELL: Let me give an example. Last year at a meeting of the association, participants tried to identify projects that would be subject to cooperative research. Even though the meeting was not planned well and allowed only one day for subgroup discussion, some of the topics were thrilling. As a result of that meeting, it was decided that WAITRO would send questionnaires to all its members to try to establish interest and competence and available resources in particular researchable areas.

I met with a group about two weeks ago to review the returns from these questionnaires. The results were disappointing. Several people here do not even know about the questionnaire, and WAITRO members were not all familiar with them. Out of the few replies that we did receive, maybe three or four had enough information that we could proceed to the next stage to ask for more information. In other words, after one year, we were hardly any farther ahead than we were at the meeting.

What is the reason for this? The reason is that many, not all, of the institutes do not know how to respond to these proposals. They respond by asking for equipment--they do not know how to respond in a programmatic or meaningful sense. And WAITRO gives them no help.

If an organization existed at the international level that could have an international core staff with competence in various functional areas that are of great interest to R&D institutes, perhaps this institution could do a more effective job in playing a brokerage role--and I mean this in a technical as well as a monetary sense. Presumably, money could be available from international organizations such as the World Bank if specific proposals could be presented. But the ARIs need help in this area. UNIDO's staff is insufficient to provide such assistance.

[This concludes the discussion accompanying the presentation on
Second-Generation Linkages.]

OTHER MECHANISMS FOR SUPPORTING RESEARCH INSTITUTES

Donald D. Evans
29 November 1979

The research institute represents an important and useful element directed toward the development objective and, as such, should be supported financially and technically. However, the research institute is but one link in the chain--it is only one element in a complex series of organizational, economic, and social interactions. Therefore, it is necessary to begin to look at those elements that both precede and follow the institutional entity and to examine the organizations that interrelate with the institutes.

What this means is that not enough attention has been given to such elements as the role of development banks. Early in the experimental program, a workshop in São Paulo, Brazil, had that as its theme--the interaction between the research institute and the bank in the developing country environment. The question of entrepreneurship also needs to be examined. DRI and others have conducted studies pertaining to this illusive characteristic in an attempt to define the conditions and environment required for people to be innovative and inventive. The Institute of Technology in Bandung, Indonesia, examines the Indonesian environment, particularly that of Java, in terms of what represents entrepreneurship in that circumstance. The question is, how does one identify the people who have the qualities needed in the technology application process? This is a serious subject and one that deserves examination.

Another element that finally has been recognized concerns scientific or economic policy. What is the degree of political maturity of the country in terms of self-examination and recognizing the role that science and technology in the institutes can play? What is the relationship of that to where people want to go in terms of their economic viability and culture? This is a difficult and serious subject. What is required is an overall examination of the economy of the country that can be related to a science and technology development policy.

The next question is, given the fairly reasonable and logical approach that was used in the research institute experimental program at DRI, should the experiment be extended into broader dimensions that people would recognize as reasonable? Such a program would build upon what has been learned and would work toward an even better understanding of the dynamic application of technology for development. The basic thesis is that it is an economic process--one in which people generally are stimulated toward self-reward. If one creates an economic incentive, it is likely to act as a stimulus. This has been demonstrated by the research grants program, which, despite structural and technical failures, was eminently successful. Therefore, the next step is to provide the elements missing in the condition that would enable the institute to be fully realized in its technological objectives. Those missing elements are questions of entrepreneurship, finance, legal structure and opportunity, and lack of restraint. If the

joint bauxite research proposal in Pakistan failed because of certain political reasons, as indicated by Dr. Ghani, then it is necessary to move in a direction that will relieve, remove, or minimize those kinds of extraneous effects that inhibit the process.

From the six years of this experiment, it has been demonstrated that applied research institutes can significantly increase their efficiency and effectiveness. But it must also be recognized that they are constrained by their environment and circumstances. It is now important to examine those constraints and attempt to change them.

To conclude, a proposal was generated and submitted for consideration at various places for the creation of a program called the Technology Development Corporation (TDC), the idea of which was to provide technical support and training, management consultation, peer group interaction, and facilities in a flexible manner. This concept should be extended into the wider dimensions of the environments within which the institutes function. This means moving in directions that actually compound the experimental complexity of the problem.

DISCUSSION

MR. MOELLER: From my point of view, the failure of the research grants program is that it was ineffectively fed into the productive system, and that productive system is, in essence, what Mr. Evans described.

For instance, he talked about the institutional aspects, such as the development bank and the financial system. He talked about the entrepreneurial aspects of the productive system, which I do not consider institutional per se. I would add to these the market. There obviously has to be a market. The most finely tuned productive system in the world will not buy the product out of the research grant. Resources are also necessary--both human and natural resources. The productive system, incidentally, is in most cases not readily amenable to injections of technology, particularly new and creative technology. So in most cases, a venture system has been developed that works in conjunction with one portion of the productive system. It is an injection mechanism into the productive system and is the high-risk point. It is the high-risk point that TDC addresses, but in order to effectively function, it must have technological input and a functioning productive system. The idea is not classifiable as either good or bad.

MR. EVANS: What has occurred to all of us is that had DRI been asked to draft the articles of incorporation of ISTC, we could not have written a better document than that which has been mandated by Congress. Implicit and explicit in that concept is the manifestation of just exactly what I am talking about.

MR. FRASCHE: Have we come back a full circle, then, in terms of concern for injection into production of the result of the grants program to the role of the AR, vis-à-vis small- and medium-scale business, because that is what most of the grants were aimed at.

MR. MOELLER: One of the deficiencies of this project was that it did not have designed into it the next step in the chain that makes use of the technology development. I might add that it is, unfortunately, a recurring difficulty with some of our projects. Consequently, the failure was not on the part of the project, and it was a failure only in the sense of omission in design. We did not realize the full potential in some of the research grants.

I mentioned that this injection point was the high-risk point, moving from a technological success into a productive system. It is the major point of risk. The concept of risk in a commercial sense is not very well understood by people who are not involved in it on a day-to-day basis. They do not understand the difference between acceptance of risks, mitigation of risks, and identification of risks. And so you will find, for very good reasons, that those in the bureaucracy tend to avoid coming to grips with this area. It is unfortunate. But it is an absolute necessity that we establish a system to accept risk.

Incidentally, when I use the term "risk," I am not talking about rolling dice. It is not a question of knowing the odds. It is just not a chance situation. I have been personally frustrated trying to come to grips with it within AID, and perhaps I can now understand better our system to come to grips with it.

Colombia has productive systems that are functioning. I am not as familiar with Thailand or with Pakistan but do know that they have productive systems. We are just going to have to be more careful in our efforts to design projects that feed an existing system. I do not know whether we can build up the portion that needs strengthening, but certainly we should more consciously feed that system.

MR. EVANS: Is there a role for government guarantee of high-risk development ventures that would interest the private investment community?

MR. SEWELL: I think so. This is an area that has to be approached with great care. In the last analysis, there are certain types of ventures in which you can define the risks. I am not sure what guidelines the average venture capital individual uses. It depends considerably on personality and outlook. But there are times, certainly, when a government guarantee or some degree of protection is a major factor in whether an investor makes a commitment of funds. We have seen that this is true domestically, and we have seen that it so abroad. This is an area in which the multinational should be more actively involved. I would like to see the multinational drawn more aggressively into financing some of the ventures that have been discussed.

MR. EVANS: What makes multinationals more able to enter into that kind of risk assumption or relationship?

MR. SEWELL: Unlike the investment bankers, they know what is involved in an operational sense. They have a feel for that market. If we are

talking about introducing a new piece of technology into a given industry, they are better able to understand and appreciate all of the implications of that risk. The banker will view it from the standpoint of the feasibility report. The multinational will also view it from that standpoint, but in addition he has a stable of technical capabilities that are able to make judgments that the average venture capitalist or investment banker cannot.

MR. MOELLER: All markets in the developing world are not the same size. As a result, costs of production, in Brazil, for example, would be significantly below the costs of production perhaps in Peru on exactly the same commodity. The international market then would be closed to Peru but open to Brazil. Other means exist to accommodate this situation, and I hope that more flexibility is created in this area.

MS. ACHMAD: First, I would like to say that I very much support continuing and extending the experimental program. We are trying to help developing countries apply science and technology for development, and this has been done through the research institutes. The most recent concept, however, encompasses integrated development, and it has been recognized that science and technology play a very important role in the integrated development effort. I support the idea of expanding activities to other sectors, which means pursuing the possibility of science and technology attracting financial resources from other sources such as development banks. This is important, because it is difficult to obtain funds for scientific activities unless you can prove that the activity is supporting development.

My second point concerns multinational corporations as compared to development banks. At this point in time, I think that the development bank will do better than the multinationals because of the attitudes of and toward multinationals. The United Nations is trying to improve the negative attitudes that developing countries have toward the multinational corporation and to improve the attitude of the multinational corporations toward investment in developing countries. This, of course, will take a long time. Many studies are being conducted, and expert groups discuss how this goal can be accomplished. However, I have the impression at the moment that the attitude is still fairly sensitive or negative toward the activities of the multinational corporations. The government must understand that the multinational corporations want to make money, but I do not think that mutual cooperation can be developed unless we find a mutual interest. The multinational corporations should also understand the objectives of the developing countries. Some countries are probably more flexible in this respect, but in general I suggest that the development bank will be more useful or beneficial in the first stage rather than the multinational.

SUMMARY AND CONCLUSION

Charles Sewell, Roger Moeller, and Barbara Lucas
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MR. SEWELL: My purpose is to summarize the various aspects of the project as reported in the last few days. As a preface to these comments, I should tell you where I come from so that you will understand something of my background and interests. I come from a background of managing technical assistance projects, which has involved industrial consulting. I speak from the standpoint of a project manager representing the private sector. I have also had some unique opportunities for several years to watch DRI. I think that this session has been especially meaningful because of the presence of the gentlemen from the research institutes.

It is obvious that the key priority for the research institute is to establish credibility with industry. Without such credibility, I suspect that it will be difficult to have credibility with government, with industrial development banks, and with multinational firms. The institute also needs its own constituency. A national science and growth policy is important, and hopefully the research institutes can contribute to the formation or development of that national policy. Certainly if they do not have a chance to contribute, then they must at least recognize their existence in those places where they do exist.

By and large, national growth policies are typically based on economic and social progress, not just technological progress. If that is the case, then technological progress is simply a means to an end--it is not an end in itself. If this holds true, it says to the institute that it can become a means to an end. The institute has, therefore, a certain kind of leverage in its relationship with government. There is no question that the institutes abroad, like institutes in the United States, are sharply affected by the political, social, and economic environments. They do not operate in a vacuum.

The management of an institute has to be competent, pragmatic, and very much aware of the forces affecting it. The goals of the institute also need strong justification in terms of technological, economic, and social needs. Once these goals are selected, they often become the basis for organizational structure, definition of functions, selection of personnel, and the solicitation of research and service projects. It is self-evident that goals will change with time. The institute needs to be flexible and must recognize that change and move with it.

The experience as described by the directors of the research institutes suggests that institutes can blend a wide range of operating functions, from economic studies to research, information distribution, and industrial extension. Perhaps the danger lies in trying to go too far either way in terms of diversifying too broadly or concentrating too narrowly. But this has particular implications in terms of the management of the institute.

The top person in the institute is the pivotal figure and should have access to a maximum degree of outside support from groups like DRI. There is a saying in corporate business management that the most important single decision that a board of directors ever makes is in its choice of the chief executive officer. This could also be applied to the selection of the individual who heads the institute.

Regarding the factor of small industry, it is undramatic in some ways, but it also represents a major segment of the employment base. Industrial extension to small industry can have a significant impact. The key to an effective industrial extension program is in the selection of personnel and their subsequent training. Personnel must have the kind of background that makes it possible for them to communicate.

I hope that in the future it will be possible for us to be more aggressive in regard to the role of the institute as an intermediary in developing joint ventures. This means that more emphasis must be placed on project promotion and industrial liaison, and again perhaps a consideration of people especially qualified in this area.

To touch briefly on the subject of multinationals, I think that they should be used where they fit. It is a mistake to try to force them. There are alternatives to development banks and multinationals, but to the degree that they blend into what hopefully is a balanced judgment about growth policy, they should be used. This may be an oversimplified approach, but it is pragmatic.

It would be interesting to consider again the potential role of the institute and its relationship to colleges and universities. I know the difficulties that can evolve in attempting this kind of working association, but hopefully, as institutes build their credibility and visibility, they might find relationships with universities desirable, and universities, in turn, might see research institutes as funnels for the flow of funds into their own resources.

More attention should be devoted to the role of banks and financial institutions, but it is important to remember that banks and investors will not be interested unless competence in techno-economic studies has been demonstrated. If you are working with an investor and make a mistake, your chances for success in this area will be sharply reduced. The standards of competence are high. I rather doubt that the average investor is impressed by the array of documents that lead to a given conclusion as long as that conclusion works.

I also think that there is a correlation between autonomy and credibility of an institution, at least in non-governmental circles. The institution funded largely by the government will be controlled by the government and, in effect, will be a captive of the system.

The main advantage of the research institutes is increased identification with industry and with the accomplishment of national economic goals. They are a means to a visible political end. This implies that the institute will be as aggressive as possible in its outreach for services to industry and in its search for visible success.

I would now like to comment about DRI. I still wonder what would have happened if we had assigned several years ago one DRI person to every institute on-site for continuity of purpose. Funding is certainly a major factor, because it costs a lot of money to keep a person abroad. But I wonder what it might have done in terms of effectiveness in relating back to the staff at DRI. Regarding the question of entry level, I doubt seriously if it is feasible for DRI to undertake efforts of additional support at entry levels in the government. Efforts have been made at entry levels in banks and key manufacturers through workshops and the grants program with limited success. This is an area of potential development that might be rewarding.

I would like to see at some point in time a greater detailed response from industry and government to the linkage established over the last few years. How will the governments and industries of Thailand, Colombia, and Pakistan react to the possibility of losing a linkage? I would like to suggest the possibility of strengthening DRI's existing contract role with multinationals, which may be an extraordinary resource. Multinationals have been referred to in regard to training access, funding, and joint ventures.

Regarding the specific area of staff development, it is self-evident that manpower is a most significant factor in this project. By creating a trained manpower pool, you are creating something as lasting as the lives of men and women, and they will be there forever. As a practical matter, a major factor in building credibility in the industrial community involves providing people who can speak the language of the client.

Major progress has been made in the area of information systems since the early stages of this contract. I am impressed with the scope of the work and the awareness of the factors at work in information transfer. This may be the "sleeping giant" of this project.

Technical assistance is a pet subject of mine and has been debated, researched, and studied from every possible vantage point. I think that DRI has made progress in this area. Any future efforts must recognize the industrial extension aspect of technical assistance in terms of impact created and credibility established.

I would rank the accomplishments of the women in development program as one of the brighter spots in this contract. This area was barely touched for a long time but has been a significant and impressive step.

In the area of research grants, the program did not have adequate funding, and it was too diffused and too small. The absence of rapport with potential consumers made it a failure. I would abandon any further activity in this area and would explore instead the implementation of research results in the real world of the marketplace.

As an outsider who has watched this project for four years, it has been interesting to watch it move from a program based on assumptions to one based on facts. It began as an experiment, and accomplished exactly that--it has demonstrated what will work and what will not work.

MS. LUCAS: I came here to learn, and I have learned much. I am impressed with the work that ORI and the linked institutes have accomplished. I do not have much opportunity in my position to deal with operational projects--I am normally called upon to make suggestions about whether a project might be workable. Therefore, I rely heavily on evaluation of projects that AID and other organizations have supported. For this reason, this seminar has been very useful.

To expound on the problem of evaluation, recipient institutions and funding agencies must recognize when they initiate projects such as this one that these experiments will probably be attempted again in one form or another. Therefore, it is important that the participants, as well as persons outside the experiment, policymakers, potential policymakers and the general research institutes, learn from each of these activities. One of the ways in which learning can be accomplished is if effective evaluations are undertaken.

There are three reasons for undertaking evaluations. One is to avoid past mistakes and to provide some history or knowledge of a program. Another is to try to incrementally improve the operation of an ongoing project. The third reason is to help make decisions about the allocation of scarce resources. Do we support IRSIs as opposed to other programs when the budget has been cut by \$50 million? What kind of projects do we engage in when resources are scarce?

Evaluation encompasses more than ex-post evaluation. It is broader in scope and includes the design of evaluation as an integral part of the project. Evaluation is incremental so that extraneous variables can be controlled. This forces us to set goals, which, in turn, forces us to set measures of our goals for a project, to collect baseline data, and to make candid statements about our expectations for what constitutes a success or a failure. This is not very popular but is important, and not enough time was spent in doing this.

We need to learn more, and the kind of experiences you have had need to be addressed to a larger community. The next time programs of this nature are discussed in the State Department, the participants will not be merely a group of people verbalizing their impressions, but a group of people who can draw on evaluations of past programs and who have a sense of what has succeeded and what has failed.

MR. MOELLER: I would like to take an entirely different viewpoint in presenting my comments. I intend to focus on the relationship of output of a particular part of this project to the productive sector and to relate this to my perception of the technology transfer process. First, there is no such thing as a technology transfer process; therefore, this is my view of the subject.

In the technology transfer process are elements called roles. Three of these are (1) a source role, (2) an intermediary role, and (3) a receiver role (see Figure 1).

Now I would like to introduce functions. I will restrict these to functions that are related to the technology involved in technology

transfer. Please keep in mind that in a technology transfer process, there are legal functions, accounting functions, and numerous others, but I am not including these in my list. In relation to the technology function, the creation of the technology is included. Usually this is not considered as part of the technology transfer process, but is an important function. Without it, we would all be out of business.

Next is the problem of assessment, a term that has many different meanings. However, I think that we all have our own understanding and our own position on what this means. Assessment is followed by the following functions: choice, acquisition, adaptation, demonstration, use, support, and improvement.

Now I will list the elements in this project: (1) staff/management development, (2) information systems, (3) technical assistance, (4) research grants, and (5) women in development.

With these three lists, I could begin to draw lines until there would be nothing but lines. You will find that most of the items in the

Figure 1
TECHNOLOGY TRANSFER PROCESS

<u>Roles</u>	<u>Project Elements</u>	<u>Tech. Functions</u>
Source	Staff/Management/Development	Creation
Intermediary	Information Systems	Assessment
Receiver	Technical Assistance	Choice
	Research Grants	Acquisition
	Women in Development	Adaptation
		Demonstration
		Use
		Support
		Improvement

Functions list are related to the Source, Intermediary, and Receiver roles, although some are not. It turns out that the effort here and the role of the industrial research institute is all of these--Source, Intermediary, and Receiver. You will move from being a source of technology, to a transfer to industry, to being a receiver of technology, and you frequently can act as an intermediary in the movement of

the technology between other people. Hopefully, you will be able to find ways of developing all of the other functions. It turns out that Staff Management Development is very important to all of the Roles and Functions. When you get down to Support, under Functions, it takes on another dimension, namely, management training support to a recipient of technology.

Information Systems permeates this system and is very important. However, one has to understand that Information Systems in a technology transfer process primarily is a support function. It is also, however, a motivational function. Technology transfer almost always starts by the transfer of information, but technology transfer truly occurs face to face with people working together. I do not want to diminish information transfer, but want to put it in context.

Technical Assistance is rather obvious here. It is an input to and output of most of the three roles. Research Grants is a problem. It had two purposes: (1) to increase competence in producing research results, particularly in a given field, and (2) to demonstrate the process involved from proposal writing to the use of the technology. Because of the lack of funding, this program was stopped short.

Women in Development is an interesting program because its initial important manifestation lies with the Receiver role. The Women in Development program was to develop competent qualified receivers of technology. The next step will be to move the program into an intermediary role. The question was brought up as to what role women play as sources. It turns out that women are already functioning to some degree, at least, in this field. It must be kept in mind, however, that you do not want to stop with just making them receivers of technology. They should be moved to the Intermediary role and hopefully be distributed throughout the system. Also, when you get into the Functions category, the Women in Development operation has been targeted into the Use and Demonstration areas. The actual program that you have may allow them to occupy the functions of Assessment and Choice.

This has been an attempt to show that we can view this program from a project standpoint and from a process standpoint, making it useful to the people who may follow us or even to ourselves.