REPORT

FINAL REPORT

CONTRACT AID/CM/ta-C-73-20

Project No. 931-11-995-991-73

METHODOLOGIES FOR STRENGTHENING INDUSTRIAL RESEARCH INSTITUTES (COUPLING WITH INDUSTRY)

Submitted to

Office of Science and Technology
Bureau for Technical Assistance
Agency for International Development
U.S. Department of State
Washington, D. C. 20523

1 December 1976

UNIVERSITY OF DENVER • DENVER RESEARCH INSTITUTE

F I N A L R E P O R T

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Submitted by

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I. INTRODUCTION

Nearly every developing country in the world has one or more technological institutes, most of which were established some 15 to 20 years ago with guidance, financial assistance and expertise provided by the United Nations. (The notable exception is the creation of the Korea Institute of Technology--KIST--with assistance from the U. S. Agency for International Development.) U.N. assistance was, in nearly every instance, for limited periods of time, after which the technological institute's government, public enterprise and the private sectors were expected to utilize the services of the institute and provide adequate financial support. The developing country governments appeared to have a genuine interest in making available, to public and private enterprise, technical assistance, research and development, trouble-shooting and problem solving, and analyses, tests, and development of standards for industrial products.

In reality, the majority of such institutes, which, in nearly every case, are civil service organizations attached to a ministry of industry or some equivalent government entity, have been largely ignored by their governments and, with few exceptions, have tended to do internal research of personal interest to the research staff member, or to replicate research which has already been done elsewhere. During the course of a two-year extensive study conducted by Blackledge, with financial support from USAID (Contract No. AID/csd-3316), approximately 60 technological institutes in 30 developing countries were evaluated to ascertain the extent of interaction between these institutes, government entities, universities, public enterprise and the public sector.*

The results of this comparative analysis were clear. In the majority of the institutes evaluated, little or no interaction was occurring with the private sector. The government entities (planning, industrial development, science councils, etc.) tended to regard their technological institutes as "ivory towers" dedicated to basic research and thus of little value as contributors to the country's industrial growth and economic development. The research staffs of the institutes, with no motivation or mandate to seek industrial problems, thus gained no experience in identification of such problems and doing the applied research and development necessary to solve these problems.

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* James P. Blackledge, The Industrial Research Institute in a Developing Country: A Comparative Analysis, Denver Research Institute, University of Denver, January 1976.

In nearly every case, senior institute management was not consulted or involved in development of the country's development plan.

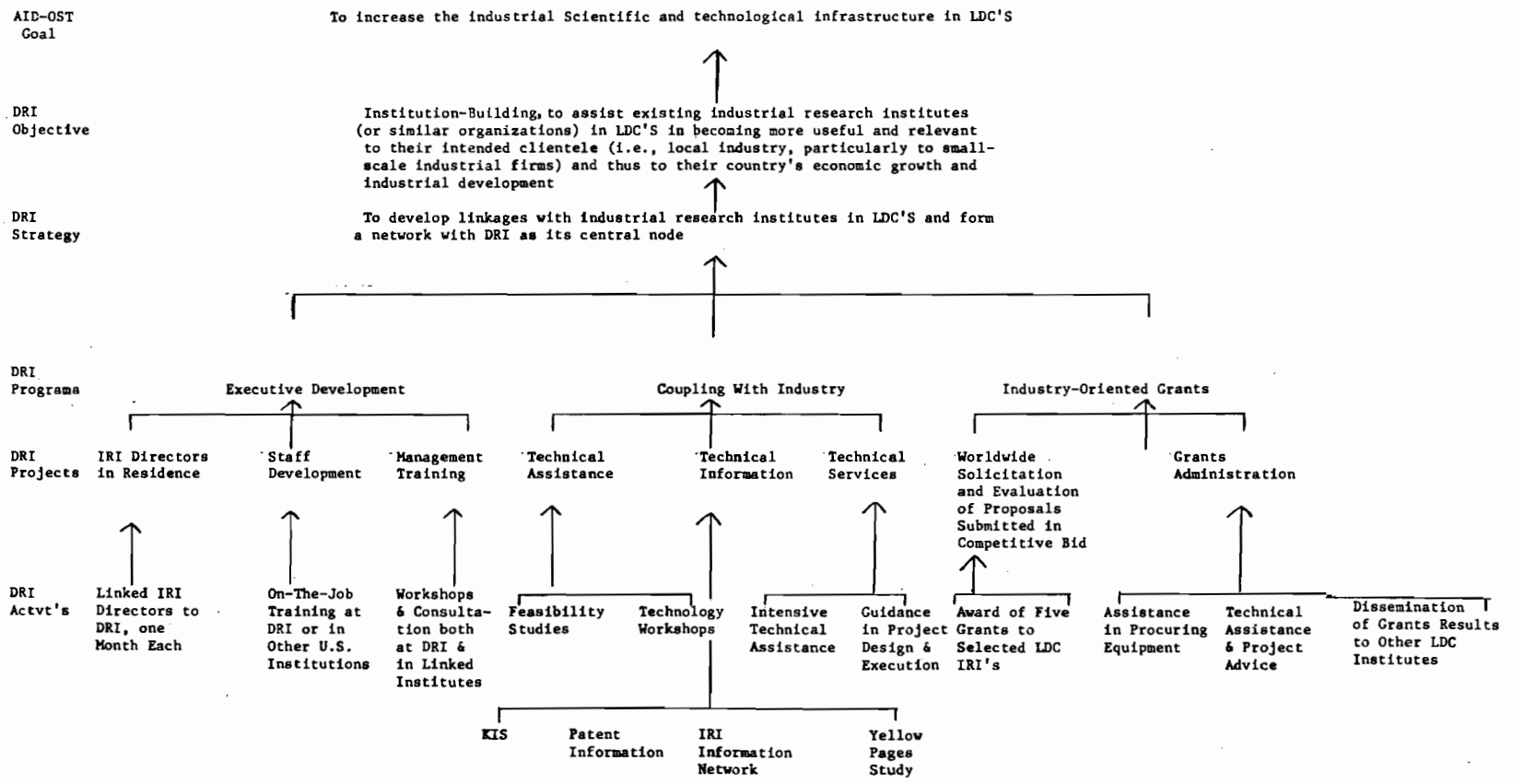
It was apparent that these LDC institutes required technical assistance and management guidance. It seemed equally clear that the concept of providing experts, as individuals representing themselves (and the U.N.) and who would probably not return again to the same institute, did not provide the continuity, the opportunity for frequent follow-up, the diversity of expertise available quickly, and the many other resources which could be supplied through a linkage between the LDC IRI and an experienced U. S. contract research institute. The mechanism of "linkage," as conceived by DRI, recognized the importance of development of understanding and trust between each linked institute, and which would most easily be accomplished by interaction between the same management and staff members of each institute on a continuous basis. U. S. institutions could make possible rapid response to needs (one to two weeks if necessary), provide access to required technical information, train LDC IRI staff, provide technical assistance, and back-stop the ongoing projects of the linked LDC institute.

Further, it seemed clear that DRI, for example, could be effective in creating a network of such linked institutes and to function as a central node in that network, exchanging and transmitting information, research results, grant activities, techniques for undertaking industrial liaison, etc. (DRI currently has linkages with IRI's or organizations in Brazil, Colombia, Guatemala, Indonesia, Korea, Pakistan and Thailand and is in process of establishing similar working relationships in Egypt, Iraq, Jordan and Tunisia. Some progress has been made, although slowly, to establish a network of these institutes.)

The LDC IRI, so linked, could be expected to benefit materially from such resources and thus develop internal and established methodologies for increased interaction with their contiguous public and private sectors.

Mechanisms for increasing interaction between technological institutes in developing countries, where USAID has technical assistance programs, have been of interest to the Office of Science and Technology for some time. Thus in March 1973, a contract (AID/CM-ta-C-73-20) was established with the Office of International Programs of the Denver Research Institute. A schematic diagram of goals, objectives, strategies, and nature of assistance provided is shown on page 3.

HIERARCHY OF PROJECT-GOALS



The objective of the program was to increase the scientific and technological base in selected developing countries, with particular emphasis directed toward assisting industrial research institutes in becoming more useful and relevant to their intended clientele (i.e., local industry, particularly small-scale industry) and thus contribute more effectively to industrial development in their country.

The tasks, as defined in the contract, were to:

1. Provide management and technical assistance to assist selected industrial research institutes in interacting more effectively with their contiguous public/private sectors, and which included:
   - techno-economic studies of industrial interest;
   - training in methodologies for promotion and program development, proposal preparation, project management and project cost controls, etc.;
   - training of IRI staff in specialized topics;
   - intensive technical assistance to several small industries;
   - know-how information service.
2. Administration of industry-oriented grants to several selected IRI's.

A companion contract (AID/CM-ta-C-73-21) was directed toward training industrial research institute managers (the final report for this contract was submitted in July 1976, and included the results of conduct of several sectoral management workshops, and preparation of a management handbook for use by industrial research institute managers).

A description of the linkages made, the problems and accomplishments follows in subsequent sections of this report. It is important, however, to note here that, while the project was planned on the basis of a three-year period, the project suffered from eleven months of no-cost extensions during the three-year period, and funds were available only to pursue the program for 25 months instead of 36. The consequences of such funding constraints have severely limited the accomplishments actually achieved. In some instances it was possible to proceed with scheduled elements of the program only by drawing on other unrelated sources of funding or by financial support from the DRI general budget.

Mention should also be made of indirect support towards the objectives of this contract, resulting from contracts and/or projects, supported by other sources of funding: USAID Mission support of training for selected staff of Instituto de Investigaciones Tecnológicas (IIT) in Bogotá, Colombia; linkages with the Instituto de Pesquisas Tecnológicas (IPT) in São Paulo, Brasil, under a USAID technical assistance loan; an Industrial Research Institute managers' workshop funded by the USAID Mission in Indonesia; ROCAP and NASA support of a continuing working relationship between DRI and the Instituto Centroamericano de Investigaciones y Tecnología Industrial (ICAITI) in Central America, and Ford Foundation funding to support the establishment of a techno-economics unit in the Federal Institute of Industrial Research (FIIR) in Lagos, Nigeria. These programs, it is clear, contributed materially to the program conducted under contract AID/CM-ta-C-73-20, by providing additional experiences and application of knowledge so gained to the problems confronting the institutes linked with DRI under this contract.

II. LINKAGES WITH SELECTED IRI'S

At the initiation of this project, based on the survey of Blackledge, and in consultation with TA/OST and the appropriate USAID Missions, four institutes were selected and offered an opportunity to form a linkage with DRI. The four institutes were:

- Applied Research Center of Middle East Technical University, Turkey;
- Federal Institute of Industrial Research, Nigeria--a government civil service institute;
- Pakistan Council of Scientific and Industrial Research--a network of four separate institutes;
- Instituto de Investigaciones Tecnológicas, Colombia--which receives less than 30 percent subsidy from government entities.

The strategy was to explore the effectiveness of the linkage with each of four entirely different organizational modes. In each case, a memorandum of understanding was developed with the linked institute and submitted to the institute or its government organization, as appropriate. Each memorandum of understanding had slight differences depending on the nature of the institute and its needs. The four memoranda of understanding are appended.

Of the four initial linkages established, only two (PCSIR and IIT) were considered to be in an active status at the end of the contract (and are continuing linkages under the new contract--AID/ta-C-1337). It is important to comment briefly on some of the factors which led to cessation of the linkage with METU and to a practically nonexistent working relationship with FIIR (except for the Ford Foundation grant made to DRI through FIIR and the Industrial Project grant awarded, in competition, to FIIR as a part of the industry-oriented grants phase of this contract).

Middle East Technical University--Ankara, Turkey

As a result of a visit to METU in November 1971, by Dr. Victor Rabinowitch of the National Academy of Sciences, Glenn Schweitzer (then Director of TA/OST), and James Blackledge of DRI, METU concluded that it was an appropriate time, because of increasing Turkish industrial growth, to establish an Applied Research Center, to coordinate ongoing University research activity, and to increase interaction between the University and Turkish industry. In June 1972, the USAID Mission requested representatives of four U. S. institutions to assist METU in formulating the policies and procedures for creating and operating the Applied Research Center.* The ARC was established in the fall of 1972.

A linkage between the Applied Research Center of METU and DRI seemed important. A DRI representative had been involved in the plans for development of the ARC. DRI is an integral part of the University of Denver and thus thoroughly knowledgeable about the nature of the problems as well as the opportunities inherent in a research institute-university relationship. The Applied Research Center appeared to be enthusiastic about a linkage with an experienced university-related industrial research institute.

The METU-DRI linkage, while fairly succinctly defined in the memorandum of understanding, did not, in reality, materialize. Instability in the Turkish Government, with subsequent instability in METU (frequent changes in the Presidency of the University and similar changes in the position of the Vice-President for Research and Director of ARC) were contributing factors to

* Review and Assessment of the Potential for Applied Research at Middle East Technical University, James P. Blackledge, University of Denver Research Institute; Stuart H. Cowen, MIT; Ross J. Martin, University of Illinois; Robert C. Stephenson, Ohio State University; July 1972.

the ineffectiveness of the linkage, as was the then-strained relationship between the Governments of the United States and Turkey.

Attempts were made repeatedly by DRI staff members to clarify certain program areas wherein METU and DRI might cooperate (the latest attempt was in April 1975), but METU failed to identify any areas of joint cooperation. Thus, in July 1975, the decision was reached to abandon the linkage with METU. Parenthetically, it is interesting to note that the current METU Vice-President for Research (Dr. Mustafa Doruk), who had promised in April 1975, a plan of action within six weeks, participated in the Management Development Workshop, conducted by DRI under Contract No. AID/ta-C-1337, in Tunisia in July 1976, and made no mention of his promise and did not express an interest in trying to maintain the linkage.

Federal Institute of Industrial Research--Lagos, Nigeria

The FIIR-DRI Memorandum of Understanding was accepted immediately by the Nigerian Ministry of Industry to which FIIR reports. Dr. Arie Beenhakker, then a member of the DRI International Programs staff, had spent the two previous years in residence at FIIR, under Ford Foundation support, assisting FIIR in developing a techno-economic capability. Continuing Ford Foundation support seemed assured (and, indeed, was received). A mutual interest in joint research existed, directed toward conversion of agricultural waste into animal protein feed supplements by fungal fermentation. Most of the senior FIIR staff had obtained advanced degrees, principally in England. The FIIR also was a recipient of an industry-oriented grant, gained in competition with 13 other LDC institutes, directed toward substitution of locally grown barley for imported wheat to be utilized in the malting process for Nigerian-produced beer.

Several attempts were made to schedule a management workshop jointly with the FIIR in Lagos, under contract AID/CM/ta-C-73-21. A considerable variety of obstacles were encountered. FIIR wanted to await completion of its conference center (finally completed in late 1976); objections were made to a workshop of more than three days; disagreement developed over who was eligible to participate.

Thus, the question must be raised: why, under what appeared to be optimum conditions, did the FIIR-DRI linkage fail?

First of all, Nigeria, as in the case of several African and Arab states, gained prominence and sudden wealth as a consequence of a decision by the major oil-producing countries to achieve a significant increase in petroleum-based income. Second, Nigeria suffered two major coups and changes in governmental direction during the attempts at FIIR-DRI linkage. The consequence of these actions was disastrous from the standpoint of the grant. The grant to FIIR consisted mainly of funds for equipment required to undertake the studies of malting barley for local utilization. Unfortunately, most of the equipment, which was provided under the grant, although ordered by DRI and apparently delivered to Nigeria, was not received by FIIR, due primarily to congested port conditions and lack of appropriate methodologies for identifying (as of July 1976) the location of the equipment, which is assumed to be somewhere in Lagos, or not as yet off-loaded.

Perhaps a more important influence on the intended linkage is the attitude of the Nigerian Ministry of Industry, which tends to regard FIIR as an "ivory tower," and thus somewhat incapable of solving industrial problems.

The Ford Foundation funding provided for return visits of Dr. Beenhakker and an intensive effort by Dr. Theodore Schlie to motivate and bring into active status the effectiveness of the FIIR techno-economics unit. While this is believed to have been successfully achieved, the feedback and accomplishments of the unit are, in reality, really unknown.

Dialogue and friendship between FIIR and DRI continue, but the linkage is regarded as nonexistent. Liaison evolves principally around the missing equipment provided by the grant. The FIIR Director spent one month in Denver in August 1973, and contact by correspondence and telephone has been maintained, but it must be recognized that the intended linkage has largely been a failure, so that an attempt to encourage and maintain the linkage no longer seems appropriate and of value.

It is important here to describe briefly the entirely different response and cooperation which have been achieved through linkages with the remaining two institutions of the four originally selected.

Pakistan Council of Scientific and Industrial Research (PCSIR)

The PCSIR consists of four laboratories and an administrative office in Karachi, Lahore, Rawalpindi, and Peshawar, a civil service organization reporting to the Minister of State for Science and Technology. The PCSIR-DRI Memorandum of Understanding was agreed to, in principle, in March 1974, and activities were initiated immediately in several areas, even though the formal agreement was not finally ratified by the Council of Ministers and the Office of the Prime Minister until February of 1976 (verbal permission to establish the linkage was granted shortly after the Memorandum of Understanding was established in March 1974).

The PCSIR-DRI linkage can be adjudged to be effective and productive, with constraints generated only as the result of funding gaps and, in reality, insufficient funds. The success of this linkage can be attributed principally to the capable and imaginative leadership of the Director of the Karachi Laboratories, Dr. M. Aslam (formerly Director of the Laboratories and now Member-Technology of the PCSIR Executive Branch).

Dr. Aslam has recognized fully the need for staff training and development, the need for increased PCSIR interaction with the industrial sector, and has been enthusiastic about activities which have led to creation of a techno-economics unit within the Karachi Laboratories, increased promotional and industrial liaison expertise, and lower-echelon training in proposal preparation, report writing, project design and management, etc. Dr. Aslam has deliberately established his operational budget for the Karachi Laboratories at an amount in excess of funds provided by the Pakistan Government (an excess of Rs 300,000 in 1974, Rs 500,000 in 1976), so that his staff, with his personal encouragement, and additional salary incentives provided from contract or technical service funds, have increased considerably their involvement in outside contracted services. His continued relationship with the PCSIR Lahore Laboratory is resulting in the initiation of similar activities in Lahore. Dr. Aslam has been aggressive in overcoming or circumventing Pakistan Government red tape which might otherwise slow the joint activities of PCSIR-DRI (verbal permission to proceed without formal approval, etc.).

Thus, the desires of Dr. Aslam and his colleagues have coincided with the program activities and goals sought by DRI. One final comment is necessary, however. Inasmuch as PCSIR is a tenured civil service organization, with staff

base salaries provided by the annual budget received from the government, PCSIR has no difficulty in assigning staff members to joint projects (feasibility studies, industrial liaison, etc.) or to assign them to participation in workshops, training, etc.

The PCSIR-DRI linkage is now entering the fourth year of cooperation, with a new Memorandum of Understanding which is even more ambitious than the previous one. There is a possibility of availability of increased funding, from the Pakistan Government and from PL480 excess currencies (through the interest of the U. S. Environmental Protection Agency), so that the activities of the linkage are expected to increase.

There is no language barrier in Pakistan; staff members have been educated in England or the United States.

Instituto de Investigaciones Tecnológicas (IIT)--Bogotá, Colombia

Unlike the PCSIR, IIT receives an annual subsidy* of less than 30 percent of its annual operating budget, so that IIT staff, by necessity, must seek external support to pay for salaries, other operational expense, new facilities, etc. The Colombian Government so far has been reluctant to utilize IIT services to an appreciable extent and has provided little support other than the aforementioned subsidies. The Director of IIT thus has available only limited discretionary funds to assign staff to non-income-producing activities, industrial liaison, training, etc. This condition has constrained the nature and extent of linkage activities which DRI originally tried to initiate. Nevertheless, some progress has been made (joint IIT-DRI-ANDI** industrial seminars, training in the U. S., with USAID/Bogotá support of nine IIT staff members in the U. S., in-house workshops, and an industrially oriented grant).

Language has provided a barrier or constraint in a few instances. Several attempts have been made to undertake joint techno-economic analyses of potential industrial projects, but either the IIT staff member has had a limited command of English or the DRI expert cannot speak Spanish effectively so as to communicate with the potential industrial sponsors. Steps are being taken to overcome this handicap, both in IIT and in DRI.

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* Donors are Banco de la República; Federación Nacional de Cafeteros; Empresa Colombiana de Petróleos; Caja de Crédito Agrario, Instituto de Fomento Industrial.

** Asociación Nacional de Desarrollo Industrial.

The Director of IIT, Dr. Norton Young L., has recently confirmed his desire to continue and to increase the number of IIT-DRI activities, so that the linkage is projected to continue for the next three years with, however, a revised Memorandum of Understanding. It is clear that some of the younger members of the IIT staff tend to be more aggressive, by nature, than senior management, so that internal pressures are being generated, in some instances, for increased interaction and strengthening of the linkage with DRI.

III. PROGRAMS AND RESULTS

The several programs and project activities undertaken under this contract have been summarized in the schematic diagram on page 3. Inasmuch as there have been a fairly large number of diversified project activities relating to overall program goals and objectives, it is deemed most effective, from the reader's point of view, to include the results of each activity to date along with the description of each activity. These results (along with related side effects and recommendations) will be repeated in the summary in Section IV of this report.

A. Management and Executive Development Programs

The objectives of the management and executive development portion of this contract were to design and conduct management and executive development courses and training for senior personnel in linked institutes, emphasizing the basic elements of R&D project development, project presentation, technical services, and fiscal and substantive project management activities.

Three categories of R&D management activities were conducted during the contract period. These were general and specialized management development workshops and executive development programs. Under the general management development category, workshops were held in Denver, Bogotá, and Karachi. A specialized workshop concerned with management from an information perspective was held in Denver. Executive development programs were held in Denver and Bogotá.

1. General Management Development Workshops

From 3 to 15 February 1974, a workshop was held in Denver that focused on management from the perspective of increasing the research institute's effectiveness in supporting industry. The workshop was attended by top management

from nine different LDC research institutes located in Guatemala, Pakistan, Turkey, Colombia, Nigeria, Kenya, Brazil and the Philippines. Subjects covered included: interaction between research institutes and local industries, estimating the price of research services to industry, proposal preparation and contractual negotiation for industrial research projects, the techno-economic function in industrial research institutes, execution and control of research projects for industry, and the role of the industrial extension system.

In July and August 1975, two one-week management development workshops were conducted in Bogotá for thirty members of top and middle management of the Instituto de Investigaciones Tecnológicas (IIT). The first workshop concentrated on budget and cost controls including: selection of projects, indirect cost computations and allocations, accountability and accountability concepts, principals of project management.

The second workshop was directed toward: external and internal influences governing IIT's relationships with government and industry, the elements of a project development and promotion program for an applied research institute, and appropriate services and functions of the applied research institute in a developing country.

Two additional one-week management workshops were conducted in Bogotá for IIT staff (with partial financial support of the USAID/Bogotá Mission). These focused on report writing and liaison with industrial clients (1 through 10 October 1975) and on proposal preparation (16 through 20 February 1976).

A workshop focusing on project planning and management was conducted in Karachi during February 1976. Thirty top and middle management staff members from the laboratories of the Pakistan Council for Scientific and Industrial Research attended. Following the workshop, the Karachi Laboratories began to implement improved project management and control procedures based on concepts presented during the course.

2. Specialized Management Development Workshop

During May 1974, a management development workshop was held for the principal officers within industrial research institutes who are concerned with industrial liaison, information management, and networking.

The workshop was attended by ten managers from nine different LDC research institutes. The countries represented were Brazil, Colombia, Guatemala, Korea, Nigeria, Pakistan, Thailand, and the West Indies.

There were several side effects noted as a result of this workshop:

- DRI was invited by UNIDO to join their information network;
- DRI was funded by NSF to conduct two workshops that focused on Latin American information needs;
- KIST requested that DRI serve as its "plug-in" to U. S. information networks;
- The participant from ASRCT has become much more involved in that institute's information management;
- The PCSIR participant has effectively utilized the knowledge gained at the workshop on industrial liaison for the Lahore Laboratories of PCSIR. Also, he and a DRI staff member are currently working on an article based on his liaison activities in Pakistan.

3. Executive Development Programs

During 1974, executive development programs were conducted in Denver for the Director of Nigeria's Federal Institute of Industrial Research, the Director of Colombia's Instituto de Investigaciones Tecnológicas, the Vice President of Applied Research of the Middle East Technical University, and the Director of the Karachi Laboratories of the Pakistan Council of Scientific and Industrial Research. Each of these programs focused on the methodologies and tactics of running an applied research institute with particular emphasis on promotion, program development, internal project evaluation, budgetary control, and delegation of authority.

In October 1975, an executive consultancy program was conducted at IIT for that institute's top six executives. The consultations focused on management aspects of motivation, recruitment, and job analysis.

The results of this activity (which is continuing under the new contract) have been as follows:

- Agreement was reached to establish and implement, under Ford Foundation support, a techno-economics group at FIIR in Lagos. As far as is known, this unit is still functional;
- Staff development needs for IIT were identified with subsequent funding obtained for support of training by USAID/Bogotá;
- At present, PCSIR Karachi Laboratories are implementing project control mechanisms such as PERT and Gantt charts, cost projections, etc., for all projects. In the future, proposals are to contain such control mechanisms. PCSIR top management is now delegating more complete authority to project managers. A project cost-accounting system is now being institutionalized. These programs were also instrumental in leading to the establishment of an industrial liaison unit at the Karachi Laboratories;
- It should be noted that following his residency in Denver, the Director of the PCSIR Karachi Laboratories initiated in Pakistan a program to encourage establishment of private R&D consulting firms. Two such firms are expected to be in operation by the end of 1976. The motivation of the PCSIR Director was stimulated by realization of advantages to both government and industry by the presence of private R&D firms, which also removes the onus of government or industry being required to seek technical advice and counsel from PCSIR.

4. Issues

During the program, as has been noted, three categories of management activities were experimented. These included intense one-on-one executive development programs for top management, general management workshops in which both middle and top management participated, and one specialized program aimed at research institute managers who were concerned with information. As the overall objective of this contract is to increase the effectiveness of industrial research institutes in their interaction with industry, each of these categories of activities seemed to have a place. It would seem logical

that, as general management concepts become familiar and understood within the institutes with which DRI is working, the emphasis of these programs should move toward that of more specialized programs.

One of the most important factors in, at least, DRI's recognition of a positive effect of the management programs on institute management was the ability to follow up the programs with subsequent visits to the institute or subsequent involvement of participants in additional management programs. Of course, there is no certainty that the management programs did not result in significant beneficial results at the institutes of participants when DRI was unable to conduct follow-up activities. It is suspected, however, that their returning to the "old" environment with no continued contact or encouragement from DRI could lead to a loss of some of the enthusiasm generated during the management program.

A number of methodologies were experimented with within the workshops. These included formal presentations, participatory lectures, case studies, role playing, group analyses, demonstrations, management games, and informal exchange of information and ideas. It was concluded that the actual involvement of participants in workshop sessions stimulated the greatest thought on their part and had the most lasting impact on their subsequent management actions. Based on participant evaluation of the workshops, this also seemed to be their view.

During the course of the contract, material more directly relevant to the management of an industrial research institute became available. This was partially a result of the generation of material specifically for workshops under this contract but was more the result of another DRI contract with AID (AID/CM/ta-C-73-21, "Executive Training Program"). Case studies and participatory lectures developed under this latter contract proved particularly effective as demonstrated by the success of the general management development workshop held in Karachi in early 1976. As noted earlier, this workshop led to a number of positive managerial changes within the Karachi Laboratories of PCSIR.

The management programs during the course of the contract were aimed at two levels of management--top and middle. The rationale was that changes in management practice would normally have to be a "top down" process. Therefore, the initial programs, those aimed at executive development and the

general management development workshop for top management, were the first to be held. These were followed by programs aimed at the middle management of the two institutes with which DRI has active linkages under this contract. This rationale is still believed to be valid.

One question that has arisen during the contract period centered on the participation of non-linked institute managers in some of the workshops. There are two arguments that can be put forth on this question, the first being that by including non-linked institute personnel, effort with the linked institutes is diluted. This is undoubtedly true. On the other hand, one may suggest that the interaction among managers from a number of institutes stimulates the exchange of ideas as well as creating useful communication channels among the particpating institutions, including the linked institutes. A number of examples of these positive effects were noted in the two workshops where non-linked institute managers were present.

A final issue concerns the use of outside faculty--i.e., non-DRI faculty. This was done on three occasions with varying degrees of success. When the outside faculty member fully understands the purpose of the workshop and the nature of the participants and can relate to them and their problems in a meaningful manner, then their presence adds a considerable dimension in terms of knowledge, interest, and diversity. On the other hand, an outside faculty member who is poorly prepared or unable to relate to the participants and their environments is, at best, a neutral factor in a workshop. As the contract period progressed, DRI believes its ability to select (sometimes in conjunction with a participating institution) outside faculty that added significantly to the management programs increased. Perhaps this was best demonstrated in the 1976 Karachi workshop where outside faculty participated in a most effective fashion, covering such areas as leadership, contracting, and legal aspecting of institute-industry interaction.

5. Recommendations

DRI recommends the following:

- To continue an admixture of training programs. The emphases of these, however, should move toward specialized workshops as general management principals are understood. Specialized focuses should include working with labor-intensive

technologies, assistance to small-scale industry and small-producer economies.

- To continue to include non-linked institutes in selected management workshops.
- To conduct at least minimal follow up with non-linked institutes and more intense follow up with linked institutes.
- To continue to employ participation as a major workshop methodology and to further experiment with others, such as "brain writing."
- To continue to develop workshop material including more case studies, participatory lectures, and management games that specifically relate to applied research institutes.
- To gradually include lower and lower echelons of management in the workshops.
- To continue to utilize outside faculty for well-defined assignments.

DRI believes that attention to the recommendations will lead to a continued increase in the effectiveness of R&D management development programs.

B. Staff Development

Staff development has been considered to be an important integral component necessary for an LDC IRI to improve interaction with industry. It should be obvious that certain elements of staff development are stimulated each time a DRI staff member or consultant visits a linked institute, conducts a seminar workshop, etc. DRI has also, however, undertaken specific staff development activities, both at PCSIR and at IIT, which are designed to increase staff experience in industrial problem identification or in institute management.

Following are staff development activities conducted during the contract period:

1. PCSIR Staff Member in Residence

A PCSIR senior staff member who will return to a responsible management position is nearing completion of a two-year graduate internship which will result in meeting the requirements for an M.B.A. in business

administration and one year (fte) of on-the-job training in research operations and management. This training has included assignments in property accountability, research accounting, project cost controls, techno-economics, technical information services, project management, etc. Costs of this training were provided from the DRI general budget during the first one and one-half years of training; such costs are now assessed against the contract.

2. Training of PCSIR Staff in Marketing Surveys

In conjunction with conduct of two techno-economic feasibility and marketing studies of completed PCSIR research projects, an opportunity was provided to give training to several PCSIR staff members (descriptions of the techno-economics studies are included in a later section).

Since PCSIR has no economists on its staff, the techno-economic surveys were conducted by utilizing a DRI engineer-economist working with a team of six PCSIR technical staff. The procedure, as developed in conjunction with Dr. Aslam, visualized a cadre system of training, whereby three members of the team for the first survey would be replaced by three new staff for the second survey, and so on. PCSIR utilized this approach on several smaller surveys where DRI assistance was not provided. It is estimated that about 20 of the PCSIR staff at Karachi have some understanding of the process of conducting techno-economic analyses of R&D. Twelve people are currently involved, either full- or part-time, in the newly created Industrial Liaison Unit at Karachi. The total staff complement is anticipated to be approximately 25 by late 1977.

3. Specialized Training for IIT Staff

Specialized training for nine members of IIT staff was arranged in a variety of U. S. institutions (eight trainees actually completed the program) with financial support both from this contract and from USAID/Bogotá. Areas of training and institutions utilized were:

- Information services and data banks--DRI, TAC of University of New Mexico, IITRI;
- Environmental controls, technology, and pollution controls--DRI, U. S. Environmental Protection Agency;

- Quality control and inspection of foods and textiles--U. S. National Bureau of Standards, U. S. Food and Drug Administration;
- Environmental controls (two people)--Denver Office of EPA National Enforcement Investigations Center, Region VIII of EPA in Houston, EPA/NEIC-Houston concerned with the Galveston Bay Project;
- Food technology--Texas A&M, Betcher Industries, Urschell Laboratories, Wenger International, International Food Technology Conference;
- Environmental controls for water quality--Rosenthal School of Marine and Atmospheric Sciences (University of Miami), U. S. Geological Survey-Denver, EPA/NEIC-Denver, and EPA/NEIC-Houston;
- Manufacture and quality control of antibiotics--U. S. Food and Drug Administration, Squibb Pharmaceutical Company, Alfa Laval Company.

It is important to examine the industry-oriented activities which are underway or about to commence in IIT as a result of this specialized training:

- IIT has initiated, with Colombian Government support, a study of the pollution problems/solutions of Cartegena Bay, patterned after the activities underway at Galveston Bay;
- IIT has expanded and increased technical information services to industry;
- IIT is promoting, with the local Squibb Pharmaceutical laboratories, a program to assist in drug and antibiotics quality control;
- IIT is expanding its already considerable involvement in food technology to include the development of food processing systems that will provide nutritional foods for both rural and urban poor (utilizing simple equipment, inexpensive packaging, processing, restructured meats, other foods, etc.).

To date, not all of the trainees from IIT have initiated new programs as a result of their new capability. Based on experiences with other LDC institutes (IPT in Brazil, ICAITI in Guatemala), it is reasonable to assume that some of the trainees will be lured away to industry, so that training must be repeated or IIT will not have capability in that area of expertise.

Nonetheless, such training is believed to have a positive net effect on the efforts of the IRI to increase its interaction with industry.

C. Coupling with Industry

The "Coupling with Industry" phase of this contract has been conducted under three broad categories: Technical Assistance, Technical Information, Technical Services. The activities with PCSIR and IIT have taken different forms, depending on the needs, interests, and capabilities of each institute. As mentioned earlier, it has become evident that greater progress is being made with PCSIR than with IIT, due to differing management philosophies, language constraints, availability of salary dollars to divert IRI staff to other than contracted services, etc. This means, of course, that a different approach must be identified and utilized for each linked institute.

Brief descriptions of project activities with PCSIR and IIT follow.

1. Technical Assistance

Technical assistance to PCSIR has been focused primarily on conduct of techno-economic studies of completed research and to establishment of an industrial liaison unit. With IIT, activities have been directed more toward increasing IIT's understanding and awareness of its potential clients and their needs. This assistance has taken the form of consultation (the executive consultancy with IIT top management was described above--III.A.3) and industry-oriented seminars. These activities are described below.

a. Techno-economic Feasibility Studies with PCSIR

It is particularly frustrating for a research institute, whether in a developed or a developing country, to expend manpower and monetary resources on the completion of a research project at the bench level and then have the research results "sit on the shelf" because there is no capability to market the research, or to take the research into a demonstration plant phase, or because the research has already been marketed elsewhere.

Research scientists who, in nearly every instance, lack knowledge about or experience in techno-economic feasibility studies, tend to blame the phenomenon of unused research results on the local industrial community, on the government, on anyone except themselves. Some of their complaints are undoubtedly correct. Yet, it has been shown time and time again that research scientists, in the absence of appropriate leadership, know-how, and incentives, tend to select their projects on the basis of scientific respectability rather than commercial potential; that research scientists often are ignorant of local industrial technological needs; that research scientists cannot or will not attempt to sell their research results to potential clients.

In the case of PCSIR, the generalized statement is perhaps somewhat too strong, inasmuch as the Director of the PCSIR Karachi Laboratories has motivated his staff, through a combination of leadership and monetary incentives, to attempt to find potential users of their research results. The problem has been that the PCSIR staff does not include economists, and the PCSIR technical staff has no background in techno-economics.

In order to improve this situation, DRI has undertaken a series of techno-economic feasibility studies with PCSIR on some of their research projects. The purposes of this activity are to:

- develop a "culture" in PCSIR of looking at research in terms of commercial feasibility;
- develop a marketing tool for PCSIR to use in marketing its research.

The typical pattern for carrying out this activity is for DRI personnel to spend two to three weeks in Pakistan with the scientists engaged in the research project* going over the basic principles and requirements of a feasibility study. An outline and itemized list of data requirements are left for the PCSIR personnel to follow through and to develop a first draft. At that point, DRI personnel return to Pakistan and a series of successive iterations ensues through several drafts until the report is judged to be ready to print. Work

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* The cadre system of expanding techno-economic capability at PCSIR was described in III.B.2.

on these reports also takes place in Denver, principally through a PCSIR resident graduate student at the University of Denver.

A list of the feasibility studies undertaken and their present status is shown below:

Feasibility Studies	Status of Report
The recovery of magnesium and potassium chemicals from the liquor (bitterns) remaining after salt has been precipitated from sea water by solar evaporation.	In press.
The processing of edible but waste "trash fish" into soluble fish protein concentrate (FPC).	First draft.
The extraction of fibre from the Mazri plant and its applications.	Decision made to initiate study.
The production of a chlorinated pesticide.	Decision made to initiate study.

An evaluation of this activity to date would certainly show that the first purpose stated above is being met to some degree. As these research projects have essentially originated in different divisions of PCSIR, the knowledge and skills required to carry out these studies have been spreading throughout the Institute. It is also apparent from interacting with the PCSIR researchers concerned that they are more aware of and sensitive to commercial requirements for the utilization of research. Perhaps the best indicator of the utility of these feasibility studies, however, is the fact that PCSIR requested two new studies to be initiated on Mazri fibre and a chlorinated pesticide. Since the first report is only now in press, it is too early to judge how successfully the second purpose has been fulfilled. Nevertheless, just the fact that PCSIR is in the process of carrying out these feasibility studies may give the government more confidence in their capabilities. Government funding has been provided for an FPC pilot plant at PCSIR, construction of which is supposedly to begin in 1976, and interest has been expressed in the funding of a bitterns pilot plant.

There have been some direct spinoffs from this activity. The Director of the Information and Economic Studies Division at ITAL in Brazil has expressed specific interest in this kind of assistance activity for that institute. Other research institutes have also indicated a more general interest in the results, and DRI intends to disseminate the first feasibility study on bitterns to them when the final report is published. Subject matter collected for the FPC study also has other uses in protein and food processing technology activities that DRI is planning to undertake jointly with other LDC IRI's.

b. Technology Workshops with IIT

Technical assistance activities with IIT have been oriented toward opening or expanding areas of potential industrial interest where IIT currently has some capability or can easily obtain such capability. Within this context, DRI and IIT planned and conducted, in collaboration with ANDI (Colombian National Association of Industrial Development), two industry-oriented seminars in Medellín in February and March of 1976. COLCIENCIAS (Colombian National Council for Science and Technology) provided moral support; ANDI provided logistical costs and support to the seminars; IIT provided staff time for seminar organization and participation.

The Packaging Seminar was held at ANDI, Medellín, February 9 through 13. More than 120 interested Colombians attended, paying a registration fee of 1.000 pesos to ANDI to defray local conference costs. DRI provided four packaging experts who presented formal papers and led informal discussions from the floor on the full spectrum of the packaging industry. Included were tin-plate, plastics, glass, wood/fibers, paper, containerization and general packaging. ANDI published the formal proceedings in Spanish. The program leader was Sr. Daniel Diaz of IIT.

The Foundry Technology Seminar was held March 1 through 5 at ANDI, Medellín. Being a more specific technology, attendance was by invitation only. Sixty industrialists attended. Financial and administrative responsibilities were the same as in the Packaging Seminar. DRI furnished one specialist on cast irons (gray, malleable, nodular, special and alloy castings plus machinery, use of tools and quality control). Another specialist

covered the broad field of steel castings (low to high carbon content, special and alloy, manganese and stainless plus machinery, use of tools and quality control).

Both specialists discussed raw materials, melting, casting methods, moulding and coremaking, quality control, applications, foundry health and safety and production costs.

Tours for all participants and speakers (several speakers were provided by ANDI and IIT) were conducted to local foundries where operations, successes and problems were observed and discussed on the spot as well as at the round table sessions.

The involvement of ANDI in these seminars is significant, inasmuch as IIT and ANDI have had little prior interaction. Continued attempts are being made to encourage and strengthen the IIT-ANDI relationship which can materially enhance IIT interaction with Colombian industry. New DRI-IIT-ANDI industry-oriented seminars are being planned (aimed at the needs of the poor as well as expanded Colombian food processing). These include:

- Food Technology

  Techniques for design and development of food--e.g., protein enrichment, fortification, extrusion, drying.

  Intermediate technology for new and conventional food products.

  Marketing techniques within low-income populations, including transport, packaging and current field experience.

- Quality Control for the Food Industry
- Possibilities in International Markets for Colombian Food Exports

IIT reports there is almost complete assurance COLCIENCIAS will contribute about $3,000 U.S. (in pesos) for local costs of each seminar. ANDI's strong interest should also develop logistical support as before.

In the interim, IIT is proceeding with the organization, within IIT, of a small group in foundry technology which will be available to solve industrial problems identified during the foundry seminar. Similarly, a packaging capability is being established. ANDI has asked IIT to establish a packaging laboratory in Medellín and presumably will provide the necessary funds. Such a laboratory will be the first attempt of branch operations by IIT. If successful, other branch operations in the several disparate geographical areas of Colombian industrialization would be encouraged, so that IIT could achieve even closer interaction with the industrial sector.

c. Technical Assistance to IIT Management

Early in the contract, and in accordance with DRI's memorandum of understanding with IIT, an IIT "Committee for Expansion and Diversification" was created, consisting of the IIT director, four sub-directors, two senior staff members, and a DRI senior staff member (as technical advisor to the committee). Each committee member was assigned one or more sectors within the Colombian infrastructure (and also international assistance organizations), with the charge of becoming fully acquainted with entities of that sector and the potential for R&D support in IIT. The duties and responsibilities of the committee were to identify, assess and evaluate potential new areas for IIT involvement or expansion of existing areas and make appropriate recommendations for action to the IIT director.

Initial results appeared promising, but, in actuality, the total results of committee action to date have not been encouraging. IIT has been involved in a series of labor-related and financial crises which have diverted the energies of top IIT management to other problems. Further, it has not been possible for the DRI committee members to return frequently to Bogotá so as to keep pressure on the committee.

The concept is still believed to be valid, however, and attempts are being made to revitalize the committee and to achieve positive and action-oriented results.

2. Technical Services

Technical services to the linked institutes have involved a variety of small activities such as technical advice and consultation (usually by correspondence) with staff members of PCSIR and IIT. In some instances

these service activities have related to techno-economic surveys in PCSIR or the industry-oriented grant at IIT. Information services are discussed in a subsequent section of this report.

Types of technical services have included:

- Guidance on converting agricultural wastes by fungal fermentation into animal protein supplements;
- Transmission of alternative energy source interests of ERDA which might be investigated in Colombia and/or Pakistan;
- Collaboration with U. S. EPA to establish environmental programs in PCSIR, utilizing PL480 funds (PCSIR, with DRI assistance, has submitted four proposals to EPA which apparently will be funded);
- Collaboration with PCSIR in preparation of a proposal to provide technical services to identify, develop, test, produce and disseminate intermediate technology suitable for village-level operations in Pakistan to process sugar cane, oilseeds, and rice bran;
- Collaboration with IIT in preparation of a proposal to provide technical assistance to a program of evaluation of the construction of small farmers' access roads in Colombia;
- Purchase and delivery of a wide variety of scientific materials and supplies on specific request by IIT. IIT has difficulty obtaining U. S. dollars, so that a revolving account has been established which permits rapid purchase of required items with subsequent repayment by DRI staff members who draw down pesos for local expenses while on duty assignments in Bogotá. No contract funds are involved in this service.

One particular technical service activity was initiated during the contract and is continuing. A somewhat more detailed description of this technical assistance--"Intensive Technical Assistance"--is appropriate here.

a. Intensive Technical Assistance with PCSIR

In conjunction with PCSIR, DRI has initiated a new approach in Pakistan of supplying technical services to local industry. The approach is for PCSIR to continue responding to requests and supplying generalized services to a number of firms but, at the same time, select one or two firms for Intensive Technical Assistance (ITA).

Intensive Technical Assistance is analogous to intensive agriculture. In addition to supplying a few technical services for a number of firms, where the impact of the services might be less visible, ITA concentrates a wide variety of technical services on a single firm which will hopefully serve as a demonstration of what technical assistance is able to accomplish. The objective is to use the ITA demonstration firm as a model to convince other firms that the institute's services can be valuable and to gain political support from the government for this effort. In order to serve as a demonstration, however, data and records (including photographs, plant layouts, product quality standards, profit and income figures, employment records, etc.) must be obtained on the "before" conditions so that there is a basis for comparison with the "after" conditions.

Two small chemical processing firms in metropolitan Lahore have been selected by PCSIR and DRI as potential ITA demonstration models. After some reiterations of what ITA meant and what its objectives were, both firms professed to understand what was being attempted and the nature of their own commitment to being used as a demonstration of the impact of PCSIR technical assistance and of the necessity to record and make available before and after evaluative data.

These firms were selected according to two basic criteria:

- Top Management Receptivity, Capability, and Commitment--no technical assistance will succeed without the cooperation and commitment of the top management in the recipient firm--this is a precondition for supplying technical services. Perhaps more importantly it appears that these firms are capable enough to work with PCSIR and to absorb the technical assistance to be offered. The objective is not to create dependent industrial clients, but rather cooperating or partnership relationships with them.

- Scope for Visible Improvements--it is obvious from visiting these firms that they are active and going concerns, but that a wide range of significant improvements could be made which should be within PCSIR's capabilities to provide technical assistance. These are not improvements that will require sophisticated mathematical models, computer programs, or complex technology--just some good, practical engineering, economics, perhaps accounting, and, most important of all, common sense in an organized or systematized framework.

Accordingly, a number of problem and/or opportunity areas have been identified and defined and are presently being worked on by DRI, PCSIR, and the individual firms.

It is too early to evaluate the success of this technical service activity. The most that can be said is that PCSIR seems to have accepted the concept and that two reasonable demonstration firms have been selected and have agreed to participate. This, in itself, takes some time and effort, however, and is an indicator that some progress has been made. Unfortunately, DRI has not been able to follow through on its commitments as much as it should have due to a lack of internal technical expertise in certain required areas and the recent gap in USAID funding.

b. Technical Service Side Effects

There have been several other LDC activities DRI has planned and/or undertaken which have been related to technical services. Ford Foundation sponsored some work with the Industrial Analysis Division of the Federal Institute for Industrial Research in Nigeria on staff training for promoting that institute's technical services to local industry. Spillover from this work has also appeared in the planning of a Program for Technology Transfer with ICAITI.

One minor related activity with PCSIR concerns the traditional reluctance of most research scientists to become involved with service work for industry. One of the hypothesized reasons for this reluctance is that the reward structure for scientists revolves centrally around publishing, and the traditional publication vehicle has been the scientific journal.

There are journals, however, in the social and behavioral sciences where more applied types of research are acceptable. Therefore, one staff member each from DRI and PCSIR is in the process of writing a publishable article on PCSIR's past experiences in attempting to supply its technical services to local industry. Hopefully this may provide some incentive for more scientific staff to become engaged in this activity.

3. Technical Information

Rather than attempt to compete with or improve on the many existing scientific and technical information systems, DRI has decided that the limited amount of money allocated to this effort might most productively be spent by experimenting on innovative approaches to technical information, and also by using this technical information to build on its other activities in LDC's. Technical information activities are described below.

a. Know-How Information Services

In a recent study of eighteen international scientific and technical information systems by James Freeman (DRI Industrial Economics Division) for the U. N. Office for Science and Technology,* a typology of three different types of problems or issues and the information systems which correspond to them was developed: Development-, Research-, and Implementation-Oriented Systems.

Of the systems surveyed, by far the dominant number fell into the Research Orientation category. Freeman concluded, moreover, that these Research-Oriented Systems came closer to satisfying the information requirements of their clients than do the Implementation-Oriented Systems. As he points out, Research-Oriented Systems can (1) plug into a readily usable, well-organized research literature, (2) serve relatively homogeneous client groups, and (3) be relatively well-financed. Implementation-Oriented Systems typically (1) cannot obtain information in readily usable form, (2) must relate to heterogeneous clients groups, and (3) are relatively under-financed.

Mr. Freeman's conclusions are supported by DRI's experience in LDC's and form the basis for the KIS experiment. In past technical assistance

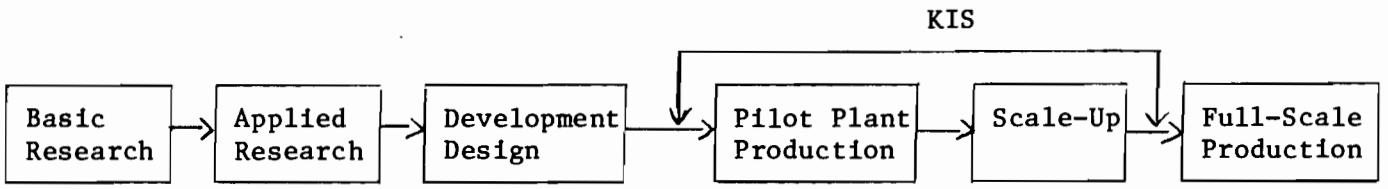
*James E. Freeman, "Improving Technological Information Exchange with Developing Countries: A Feasibility Study on the Progressive Establishment of an International Information System for Technology Transfer and Assessment," Phase I Report, University of Denver Research Institute, February 1975.

efforts with the Pakistan Council for Scientific and Industrial Research (PCSIR), DRI has assisted in the development of two techno-economic feasibility studies on research which PCSIR has carried through to the pre-pilot stage:

- The recovery of magnesium and potassium chemicals from the liquor remaining after salt has been precipitated from sea water by solar evaporation, and
- The processing of edible but wasted "trash fish" into a soluble fish protein concentrate.

It is intended that PCSIR use these feasibility studies as marketing tools to attract support for further funding of these projects from government or private industry. A pilot plant for the fish protein concentrate project has recently been funded by the Pakistan Government, and the chemical recovery process may also be funded soon.

It is this information gap in the technological innovation process that DRI hopes to address with KIS. At the point when a technology leaves the laboratory and begins to be applied commercially, an entirely new set of information requirements emerges which may or may not be related to the previous scientific and technical effort. (See figure below.)



These requirements may relate to such things as:

- the construction of pilot or larger-scale plants (e.g., materials, layout, blueprints, health and safety of workers, plant location and access);
- the supply and purchase of needed equipment (e.g., alternative local suppliers, alternative foreign suppliers, purchasing or contracting know-how, import restrictions);

- the operations of pilot or larger-scale plants (e.g., possible or even likely start-up problems ["bugs"], out-of-the-ordinary repair and maintenance, the disposal of large quantities of waste effluents, the order and purchase of inputs, maintenance of supply and product inventories); and
- the marketing of products (e.g., training and management of a sales force, distribution and transportation, sales contracting and management of accounts receivable, accounting systems, national tax requirements).

These are difficult information requests to satisfy, particularly in developing countries.

On a recent visit to Pakistan, the KIS concept was discussed with PCSIR, and it was agreed that DRI and PCSIR would attempt to:

- anticipate the know-how information needs of potential industrial implementation projects for which PCSIR has developed the technology, before the technology leaves the laboratory;
- begin collecting information relevant to those needs from whatever sources are available;
- assemble and package this information into a readily usable form;
- provide the information to PCSIR and assist in follow-up activities as appropriate; and
- evaluate the usefulness of this information in terms of such measures as time or cost savings, quality improvements, etc.

Once the information needs for the Fish Protein Concentrate (FPC) pilot plant were considered, several specific information requests were generated:

- To supply information on alternative suppliers of equipment items which were to be imported;

- To supply information on alternative suppliers of equipment components needed for machinery already acquired by PCSIR;
- To supply information on older designs and working drawings of fish dryers in particular or dryers in general;
- To supply information on marketing and/or economic reports which had been prepared for FPC or magnesium and potassium chemicals;
- To supply information on what start-up problems or "bugs" might be anticipated with respect to the FPC and bittern pilot plants.

Some of DRI's efforts to at least partially satisfy these requests are described below.

Suppliers of Industrial Equipment. One of the continuing complaints which developing countries have with respect to the purchase and import of technology--machinery/equipment, components, systems, entire plants--is a lack of information of alternative foreign suppliers. Often, only one or two suppliers are known; suppliers with whom the developing country customer has dealt with in the past, many times based on historical ties. This lack of information puts the customer at a disadvantage in that he is unable to "shop around," evaluate alternative technologies, and negotiate to derive the best possible bargain. Information on possible alternative suppliers of jet spray nozzles, for example, is probably available somewhere, but in a disaggregated form at best and not in a reasonable time period in Karachi.

In attempting to deal with this issue, DRI has developed a working relationship with Information Handling Services (IHS), a private firm based in Denver. IHS's product is VSMF, which stands for "visual search microfilm file." On different sets of microfilm cassettes, information from thousands of industrial suppliers is edited and organized. Catalogues and standards and specifications documents are frequently updated. The heart of the service is the indexing system, which has been developed over many years and which is applied by experienced engineers to the mass of catalogue data which is the input to the

system. Through the use of this system, the design engineer, manager, or purchasing agent can, within minutes, identify all* the manufacturers of a particular product (e.g., continuous centrifuges) in the system, as well as view the actual catalogue pages describing the products of interest.

In working with DRI, IHS has supplied, on an experimental basis, this type of information on the equipment and equipment components that PCSIR needs to import to start up a Fish Protein Concentrate pilot plant.

This information has indeed proved to be useful, but DRI uses it primarily as a starting point in identifying entry points into the techno-economic "networks" that exist for FPC and every other kind of techno-commercial product. Other sources of information used for the same purpose have included internal expertise at DRI, trade journals and publications, the yellow pages, Thomas Register, advertising directories, Dun and Bradstreet, Standard and Poors, the Funk and Scott Index, business periodicals index, used equipment catalogues, and the like.

The mode of operation for KIS in North America is simply the telephone. Once into the network, it has been DRI's experience that a wealth of information will be made available if people are approached in an honest and unassuming way. This information will include further references of experts/consultants/researchers in the field, companies in the field (both manufacturers and their customers) , brochures and other documentation of products, processes and services, and general advice and foreign experiences. If specific items of equipment are being discussed, DRI attempts to obtain as much as possible of the following information: cost (both initial and life cycle), expected life, capacity limitations, energy, water, and raw material requirements (including quality standards), labor intensity, skilled labor requirements, spare parts availability, maintenance requirements, guarantees, shipping and delivery conditions, start-up assistance, possible licensing, trademark, or copyright restrictions, space requirements, other countries where supplier has equipment for sale and/or representatives stationed, etc. At present, initial information of this type has been sent to PCSIR and is being evaluated by them.

*Over 7,000 manufacturers of equipment and materials and 9,000 manufacturers of parts, components, and materials used in original equipment design are covered by IHS. This coverage is largely limited to the U.S., although some suppliers from Western Europe and Japan are now being included. The ultimate information system, of course, would have worldwide coverage of suppliers of industrial equipment--including those in the developing countries themselves.

Marketing of Commercial Products. Information related to the markets for and marketing of the products of a commercial technology is very important to the ultimate success of technological ventures in all countries. DRI takes generally the same networking approach to obtaining market and marketing information as described above for the suppliers of industrial equipment. In identifying network entry points, however, the market strategy to be used can be as important as the product itself. PCSIR, for example, intends to market soluble FPC in the form of a "tonic" or "medicine" rather than as a food additive, which is the more common approach. Therefore, DRI also contacted the producers of similarly marketed products in the United States such as health foods, Geritol, Vitamin E, and cod liver oil in order to obtain information.

Once into the network, a surprising amount of marketing information is made available. This information comes in the form of references to or copies of articles from trade publications, journals, newspapers, etc.; basic advertising facts and figures for specific companies; reports produced for governments; and internal company reports, brochures, or other documents. In supplying PCSIR with this information, DRI is not suggesting that marketing strategies or studies carried out in the U.S. environment are necessarily appropriate in Pakistan. Rather, this information is intended to stimulate Pakistani interest in carrying out their own studies and to emphasize to them the importance of developing a marketing approach to R&D.

Although information on alternative suppliers of industrial equipment and the marketing of commercial products is currently being transferred to PCSIR principally for its own internal use, the use of information does not stop there. As the usefulness of KIS is demonstrated to PCSIR, they, in turn, should begin to market this service to local industry. Already some initial efforts have been made in this direction. During a DRI staff member's visit in December 1975, two local industries were visited and particular information needs identified. Those requests have been handled by KIS and delivered to PCSIR.

Patent Information. Potential sources of information that often have been referred to in terms of positive expectations of their value, but which have never (to DRI's knowledge) been exploited systematically for the benefit of LDC's, are the patent files which exist in countries like

the United States. Included in these massive files, according to this viewpoint, should be technical designs, drawings, blueprints, models, etc.--i.e., information--that would be of much use to the design engineer in LDC's, even if that information has been ignored or is outdated in the developed countries.

In order to test the value of this patent literature, DRI has initiated an experimental project with respect to a specific item of equipment for which PCSIR has requested this kind of information--dryers. Dryers appear to be important items of equipment in the food processing and chemical industries, both of which are prevalent in Pakistan and other LDC's. Pakistan does not necessarily need the most modern and technically sophisticated dryers; information on older but still reliable and cost-effective dryer designs that can be adapted or redesigned to be manufactured locally is what is desired.

In attempting to determine if useful information of this nature was contained in the patent files, DRI has undertaken the following steps:

- A familiarization with the patent search process and the patent files in Washington, D. C.;
- The identification of a professional patent search law firm and discussions with them to achieve an understanding of the goals of this experiment;
- The negotiation of a contract with this firm to do a professional search for spray and tray/cabinet dryers. The instructions emphasized the importance of designs, blueprints, or other information in the patents which would indicate how the dryer might actually be constructed. Both obviously old or obsolete and very new or sophisticated information was to be avoided;
- The search resulted in 92 patents, ranging from 1868 to 1968;
- Evaluative comments have been made and attached to selected patents by DRI technical personnel.

PCSIR will assess and evaluate each of the 92 patents and provide DRI with appropriate feedback on their usefulness. It is not expected that a single patent will be found which will satisfy all of PCSIR's information needs, but

rather that relevant technical features from many patents will be incorporated by PCSIR into an institutional reservoir of design know-how from which they can develop their own dryer designs. DRI intends to follow through on this activity by providing technical assistance where it is required and appropriate.

b. Industrial Research Institute Information Network

Looking beyond specific information activities with specific goals or with specific industrial research institutes, in carrying out all of its international tasks, DRI is accumulating a great deal of information.

If this information is organized and properly stored, it could be useful to other institutes in the future. A number of developing countries have similar needs (e.g., nutrition, population, energy) and often conduct research in similar areas. In such cases, equipment information, marketing information, pilot plant information on a certain technology could be helpful to a number of institutes. By setting up a working system, DRI could serve as a center for information on technological developments and expertise in LDC's.

For example, an LDC research institute might want to know how to set up a pilot plant for producing coconut oil soap. DRI might be able to provide them some marketing information and equipment ideas. As well, DRI might be able to name another LDC that has undertaken a similar project and perhaps has a specialist that could be of some assistance. Not all information--whether in the form of documents or technical consultants--would come from the developed countries.

In order to serve in such a capacity, DRI has started to design and develop an information system so that:

- information already collected can be recovered quickly and easily by any staff member;
- information obtained through future KIS or other information activities can be easily stored and incorporated with other information so as to be effectively used at a later date;

- information not on hand at DRI can possibly be located through other sources, i.e., institutes identified by DRI.

c. Ongoing Information Assistance

As part of the overall assistance program to IRI's, DRI continues to act as a backstop to any information needs of those institutes. At times there still are requests for research-oriented information, documentation, or general state-of-the-art background material. We respond to such a demand through our university library services and DRI technical division resources. For example, we conducted a computer literature search for IIT on the utilization of wood wastes and send to them over 50 articles and references on the subject.

In a case where DRI is not able to answer a request or feel there is a group more appropriately prepared to do so, DRI serves as a referral. We try to bring to the IRI's attention, the many services available in the U. S. and the best way to access them. In certain situations where overseas communications impede transactions of both information and goods, DRI has attempted to serve as a broker. Through our international information conferences, professional meetings, and expanding staff of information specialists, we hope to improve this role as a backstop, referral, broker and provider of know-how information.

There have been several side effects resulting from DRI's technical information activities. These include the following:

- DRI has planned and conducted, with NSF and State Department support, a conference on the "Role of Scientific and Technical Information in the Transfer of Technology to Latin America." A companion activity, also funded by NSF, is leading to implementation of some of the ideas which emerged from that conference;
- DRI has recently been funded by ROCAP to assist in the experimental testing of a Program for Technology Transfer (PTT) based at the Instituto Centroamericano de Investigacion y Tecnologia Industrial (ICAITI) for the countries of the Central American Common Market;

- A DRI staff member was retained by UNIDO to conduct a study of North American potential technical information inputs to an Industrial Technological Information Data Bank being planned by the UNIDO International Center for Industrial Studies;
- Requests for KIS assistance have been received from KIST, ITAL, Universidade Estadual de Campinas (Brazil), the Chilean Institute of Technological Research, and ITINTEC in Peru.

4. Industry-oriented Grants

DRI has established several industry-oriented grants on a competitive basis with selected LDC research institutes. The grants are intended to assist these institutes in transforming suitable technology into useful industrial products or processes and to demonstrate to local industry the tangible benefits to be derived from utilization of the resources of the institute. The grant awards provide principally for adaptation or applications of presently known technology to local country conditions. Projects were developed around proposals to develop processes or products, construct pilot plants or demonstration plants, or to carry out other R&D projects which will assist the LDC research institute in initiating new industrial activity.

The grants activity was initiated by announcements describing the nature of the grants program and a request for proposals to be submitted on a competitive bid basis. Nineteen institutes, in countries of USAID interest, received the announcements.

Eighteen institutes submitted 34 proposals with a face value of $950,000 (U.S.) ($200,000, U.S., was available for grant support). Nearly all of the proposals received were well prepared and appeared to address the problem of potential industrial utilization, although actual apparent interaction by industry was disappointingly low. Staff members of Battelle Memorial Institute, Arthur D. Little, Inc., and Southwest Research Institute evaluated the proposals. Of the total, 15 were adjudged to be worthy of funding. Due to funding limitations, however, it was possible to fund only five institutions. These were:

ASRCT, Thailand	Rubber Seed Oil
FIIR, Nigeria	Malt Substitution
ICAITI, Guatemala	Gossypol Reduction
IIT, Colombia	Refinery Effluent Recovery
KIST, Korea	Wheat Flour Substitution.

As might be expected, the limited funding available for grant support and the small number of grants awarded, in view of the number of proposals technically acceptable, evoked some comment and criticism from various of the institutions that had prepared proposals which were considered good by the evaluation panel but which were not funded.

Some attempts have been made to interest a variety of potential clients in the ten unfunded proposals. These have included the USAID Missions, local industry and local government, and other international assistance organizations. To date, such effort has produced negative results. Thus, during the second round of grant initiations, a more selective approach will be utilized to avoid overstimulating too many institutions, resulting in a response greater than can be effectively handled.

On the grants administration side, it soon became apparent that the contract funding was wholly inadequate for maintaining the necessary continuity of contact and interaction with the grantees that was considered optimum. There were discontinuities and hiatuses which resulted in extended periods during which only limited attention could be given to the grant projects. This was greatly compounded by various difficulties in acquiring and shipping items of research equipment which comprised, in two instances, the principal grant support.

Despite this spotty performance, it now appears that, of the research projects, two (KIST and ICAITI) show good promise of realizing commercial impact, two (IIT and ASRCT) still seem to have the potential for realizing significant benefits but need to be reviewed and encouraged, and one (FIIR), due to a combination of unforeseen and force majure circumstances, does not appear to be progressing well.

Brief descriptions of the five grants and the accomplishment of the grantee institutions follow:

a. IIT/Bogotá. A refinery near the capital city of Bogotá has been dumping highly caustic waste effluent (cresylic and napthenic acids) into the region's principal river, causing unacceptable pollution levels. In cooperation with the refinery management, IIT was to conduct laboratory process development research and to design and build a demonstration unit for the neutralization and removal of the waste material, making it possible to dump the effluent without consequent negative effects on the suitability of the river water for domestic and industrial uses. It is thought possible that the commercial value of the recovered waste material may be sufficient to significantly offset the processing costs, although this will necessarily depend upon the costs of various process chemicals which are utilized in the method IIT has developed.

While the industry involved, Proquimsa, appeared to be very interested in a collaborative arrangement, over one year (September 1974, to November 1975) was required to sign a contract which would permit IIT to utilize Proquimsa wastes in conducting a pilot plant study. Although IIT was provided laboratory samples for analysis and conduct of a preliminary techno-economic analysis, their results were apparently in conflict with the erroneous opinions held by some Proquimsa directors relative to economic recovery potential vs. operational costs to recover the effluents. The contract was finally signed after IIT was able to demonstrate that another oil refinery in Colombia was selling spent caustic soda at a profit.

The consequence of this indecision on the part of Proquimsa is that completion of the grant project has been delayed by approximately eight months. Further, delays have also resulted because Proquimsa, in signing the contract, insisted on changing the refinery source of effluents so that laboratory work had to be repeated.

An interesting side effect from this grant, which relates directly to DRI workshops at IIT on project management and controls, is the attempt by IIT to apply PERT and other project planning devices to conduct of the grant (see Diagrams 1 and 2 following). Even though IIT has not met the goals which they themselves forecast, it is encouraging to find that they are at least attempting project planning and management.

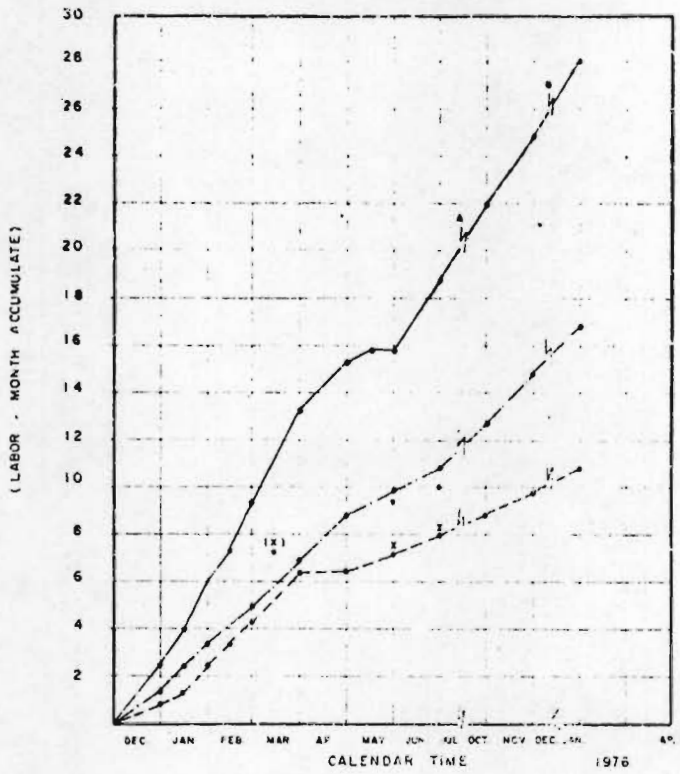
GRAPHIC 1

BUDGETARY STATE OF PROJECT

SPENT CAUSTIC WASTES RECOVERY

DATE NOVEMBER 21 OF 1975 REVIEW NUMBER : 5

CUMULATIVE EXPENSES AND LABOR

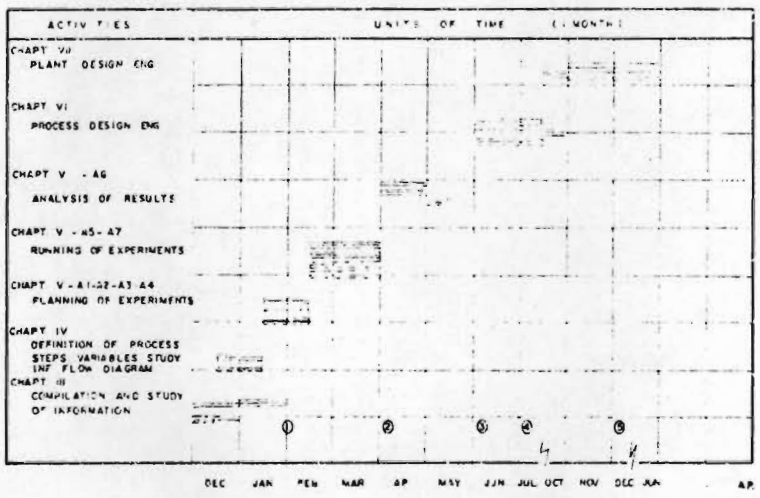


EQUIVALENT COST :
- PROFESSIONAL @ US $ 1 250 / MONTH
- AUXILIAR @ US $ 400/ MONTH

CODE REVIEW
- ° PROFESSIONAL
- x AUXILIAR
- ▲ INTERRUPTION OF LABOR
- ■ INTERRUPTION OF LAEOR

AT THIS POINT THE FINAL REPORT MUST Be SUBMITED

CHRONOGRAM



CODE
- PROFESSIONAL
- AUXILIAR
- ACTIVITIES ADVANCE
- ① = 1ST REVIEWING JAN 30 - 75
- ② = 2ND REV. MAR 31
- ③ = 3TH REV MAY 31
- ④ = 4TH REV JUN 30
- ⑤ = 5TH REV NOV. 30 - 75

PROGRAMMED VS EXCECUTED BUDGET AND TIME CONFRONTATION : 5 TH REVIEWING

ITEM		PROGRAMMED		EQUIVALENT EXCECUTED		EQUIVALENT DIFFERENCE	
		HRS	COST US$ 2/	HRS	COST US$ 3/	HRS	COST US$
PROFESSIONAL	A	300	2.340	283	3705	+ 17	- 1 365
PROFESSIONAL	B	700	5.470	1391 1/	7.592 1/	- 691	- 2 122
PROFESSIONAL	C	400	3.120	755 1/	4577 1/	- 355	- 1 457
PROFESSIONAL	D	240	1 870	205 1/	1209 1/	+ 35	+ 661
AUXILIARS		2400	6 000	1231	507	+ 1169	+ 5 493
		4.040	18 800	3100	17500	+ 175	+ 1 210
CHEMICALS & MATERIALS		-	1.000	-	300	-	+ 700
EQUIPMENTS 2/		-	8 850	-	2.500	-	+ 6350
		-	9 850	-	2800	-	+ 7050
TOTAL			28 650		20300		+ 8941

1/ TEN PROFESSIONALS HAS BEEN INVOLVED IN ACTIVITIES B,C AND C

2/ VALUES INCLUDED ON PROPOSAL

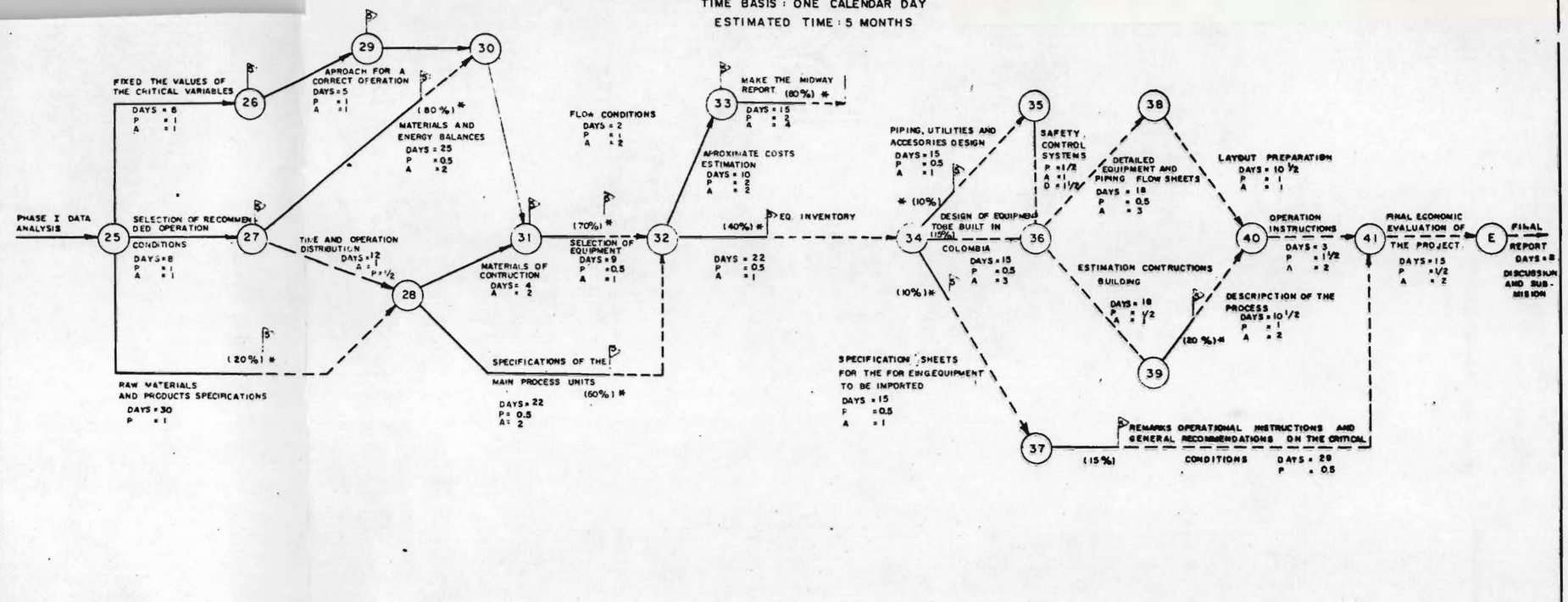
3/ THIS AMOUNTS ARE RESULTING TO TRANSFORM THE COLOMBIAN PESOS REALLY SPENT, AT THE RATE OF [illegible] EQUIVALENT MEAN VALUE

DIAGRAM 2

ACTIVITIES, TIME AND LABOUR PROGRAM CONTROL FOR THE SECOND PHASE OF THE PROJECT 1/

TIME BASIS : ONE CALENDAR DAY

ESTIMATED TIME : 5 MONTHS



CODE:
- P = PROFESSIONAL
- A = AUXILIAR
- O = MAIN ACTIVITIES
- ------ = PROGRAMMED ACTIVITY
- ——— = PART ALREADY COVERED; (%) * IN PERCENTAGE
- ▷ = FIFTHCONTROL : NOV 30-75
- 1/ = SECOND PHASE : PROCESS DESIGN ENGINEERING AND PLANT DESIGN ENGINEERING.
- 33) = THE FORMAL MIDWAY REPORT WAS ALREADY PREPARED ON TIME Mr. DONALD D. EVANS, AGREED TO WAIT UNTIL THE END, FOR TRANSLATION AND REFINEMENTS COMMING FROM THE SECOND PHASE DATA INCLUSION

b. ICAITI/Guatemala. Cottonseed cake, the by-product of the cottonseed oil extraction process, can serve as a valuable source of protein for animal feed. However, in the untreated condition, the cottonseed cake contains gossypol, a substance which is toxic to mono-gastric (single stomach) domestic animals. The ICAITI grant project is to develop an inexpensive heat treatment and chemical process which will reduce gossypol levels sufficiently to permit the direct feeding of the processed cottonseed to all varieties of livestock.

ICAITI, prior to award of the grant, had completed the bench research which demonstrated the potential technical and economic feasibility of the proposed process, and has been issued a basic patent. Under terms of the grant, a pilot plant was constructed and a series of trial runs made to verify the laboratory results. The grant has now been successfully completed. ICAITI has been able to demonstrate that reduction of gossypol content in cottonseed cake to acceptable levels can be achieved, without reduction in protein and lysine content, on a commercial basis and at reasonable cost.

One of the largest processors of cottonseed oil and cake (Kann Brothers in Guatemala) has followed closely the results of the pilot plant operations, and negotiations are currently taking place between ICAITI and Kann to license the process. Several animal feed companies have been given sample feed formulations, using the process, and appear to be interested in supporting additional developmental work to meet their own needs. The computer feed formulation program of Corn Products Company of the U. S. has been made available to ICAITI for evaluation of the economics of several feed formulations utilizing the ICAITI gossypol reduction process.

DRI and ICAITI have discussed ways in which details of the process can be released to potential users in other developing countries, possibly on a licensing basis.

The grant has been satisfactorily completed, although ICAITI will continue to cooperate with animal feed formulators to demonstrate effectiveness and utility of the process.

c. FIIR/Lagos. Nigeria uses significant quantities of imported wheat in the brewing of domestic beer, despite the fact that the country produces cereal grain, particularly barley, which can be utilized in brewing beer. The FIIR grant project is intended to develop a process for utilizing significant quantities of Nigeria-grown barley to substitute for this imported wheat. The research includes extensive malting tests based on the Nigeria-grown grain in order to determine the optimum conditions for its utilization in the domestic brewing industry.

The grant to FIIR has comprised primarily laboratory equipment necessary for conducting these malting studies and establishing quality control procedures utilizing the home-grown grain. Unfortunately, some of the grant equipment has apparently been lost en route to FIIR with the result that full-scale work is not as yet possible.

In the interim, FIIR has proceeded, to the extent of its facilities, in conducting some preliminary malting and fermenting studies on barley, sorghum, and millet and has some indications of satisfactory malting capability for locally grown barley. Completion of the study is now being held up by lack of the equipment, which was not received.

The insurance adjustor for one piece of equipment has settled the claim, and FIIR will soon receive replacement equipment. Inasmuch as the insurance adjustor for the second item of equipment has refused to honor a claim (based on technical problems of delivery in Nigeria), FIIR has agreed to purchase this equipment from its own funds. It is anticipated, however, that completion of full-scale demonstration plant studies will require approximately one year after the equipment is installed.

FIIR has been prompt in reporting research results to date and is keeping DRI informed about the status of the equipment replacement.

d. ASRCT/Bangkok. Oil extracted from rubber seed, an unutilized byproduct of the rubber plantation industry, is unstable and will deteriorate unless combined with stabilizing chemicals. In the stabilized condition, the rubber seed oil finds application as a paint vehicle and dryer, similar to linseed oil which is presently imported into Thailand in significant quantities.

The grant program has resulted in the delivery in Thailand of a fifteen-gallon electro-vapor plant for use in developing a rubber seed oil stabilization process. This equipment is a commercial-scale pressure vessel capable of uniform, controlled heating of the contents at elevated temperatures and pressures, while under agitation.

After initiation of the grant, and prior to the arrival of the above-mentioned equipment, the ASRCT project leader, Dr. Bancha, resigned, thus necessitating organization of a new team to undertake the grant. Further, upon arrival, it was found that the reaction kettle heating elements were malfunctioning. Thus, several delays have resulted in postponement of the grant until May 1978, instead of contemplated completion by September 1977.

In actuality, the new team is believed to be better qualified and more versatile than the original team. In addition to the project coordinator, a chemical engineer, the team consists of the project leader, a woman with degrees in industrial chemistry and industrial instrumentation, a chemist, a chemical engineer, and an industrial economist.

The team has successfully solicited the cooperation of a Thai paint firm, ICI (Thailand) Ltd., and is utilizing ASRCT-produced drying oils in some of ICI's paint formulations on a trial basis.

Laboratory studies relative to production of a better quality drying oil and a refined rubber seed oil are essentially complete. Economic surveys have been made of the potential availability of rubber seed (necessitated by the recently launched rubber tree implantation program, which may cause a temporary shortage in availability of commercial quantities of rubber seed) and the potential availability and variability in quality of rubber seed oil currently produced by several small-scale vegetable oil extraction plants.

Although delayed, it appears that the grant will be successfully completed and that the grant results will find immediate usage in commercial paint formulations.

e. KIST/Seoul. Korea imports large quantities of wheat, primarily from the United States, and this is a major foreign exchange demand. At the same time, with growing affluence, the Korean people have an increased preference for bread and other bakery products made from wheat flour. The KIST

research project, which has just been completed, has established the limits and conditions under which domestically grown barley may be substituted in ratios as high as forty percent for imported wheat in the manufacture of flour for use in pastry, pasta and breadmaking.

Barley production in Korea can be rapidly and dramatically increased by planting it as a second crop after the rice harvest in the summer. Thus, a very large supply of this cereal grain can be produced within one season, not only resulting in saving of foreign exchange but simultaneously having a significant impact on rural incomes.

One final point is germane to the grant activities under this contract. Grant awards to FIIR and ASRCT (both of which receive principal salary support from their governments) were in the form of equipment only. In the case of KIST, IIT and ICAITI, each of which must recover all costs, the awards were made on the basis of a complete, contracted research project in which grant monies were used to pay all costs--staff time, materials, equipment usage and overhead. As an observation, it is clear that DRI can exert more control over successful completion of the grant under such contracted research conditions than is possible when institutes such as FIIR and ASRCT are providing their own staff time and, thus, are less subject to the pressure of completing the grants on time. As has been indicated above, however, both ASRCT and FIIR have been confronted with difficulties in equipment acquisition and utilization but have nonetheless pursued their grant objectives to the best of their abilities.

Perhaps the significant point is that more grant completion time must be programmed when the grant involves provision of equipment or components not already available.

IV. SUMMARY

As mentioned in an early section of this report, due to the number and diversity of activities undertaken under the contract, each activity has been summarized at the end of the description of that activity, since this is believed to be more convenient for the reader. However, these activity summaries and the activity side effects are repeated here as a summation of the overall activities under the contract.

1. Linkages

Of the four initial linkages established, only two (PCSIR and IIT) were considered to be in an active status at the end of the contract. Due to a variety of circumstances, linkages with METU and FIIR did not actually develop much beyond the memorandum of understanding phase.

The linkage with PCSIR is considered to be effective, and a variety of activities is underway, including staff development and management training, techno-economic and know-how information assistance, and small industry assistance. PCSIR management has been aggressive in implementing new project management and control procedures and in increasing its interaction with Pakistan industry, using the tools and assistance provided by DRI.

The linkage with IIT has been less intensive and has been focused more on staff development and training seminars which are expected to open new areas of potential interaction with the Colombian industrial sector.

2. General Management Development Workshops

Six workshops were conducted during the contract period. Of these, one workshop, conducted in Denver, included participants from, in addition to the linked institutes, senior IRI management from Guatemala, Kenya, Brazil and the Philippines. The purpose in including participants other than from the linked institutes was to provide a forum for exploring the variety of research institute management problems confronting LDC IRI's.

The other five workshops conducted in Pakistan and Colombia focused on internal project management, project cost controls, promotion and industrial liaison.

3. Specialized Management Development Workshop

One workshop was conducted in Denver for principal officers within the linked IRI's who are concerned with industrial liaison, information management and networking. In addition to representatives from the linked institutes, participants were invited from Brazil, Guatemala, Korea, Thailand and the West Indies.

4. Executive Development Programs

"In residence" programs were conducted in Denver for the directors of each of the four linked institutes. These programs focused on methodologies and tactics of running an applied research institute, with particular emphasis on promotion, program development, internal project evaluation, budgetary control, and delegation of authority.

One executive consultancy program was conducted in Bogotá for IIT's six top executives. The workshop focused on management aspects of motivation, recruitment and job analysis.

The results of this activity (which is continuing under the new contract) have been as follows:

- Agreement was reached to establish and implement, under Ford Foundation support, a techno-economics group at FIIR in Lagos. As far as is known, this unit is still functional;
- Staff development needs for IIT were identified with subsequent funding obtained for support of training by USAID/Bogotá;
- At present, PCSIR Karachi Laboratories are implementing project control mechanisms such as PERT and Gantt charts, cost projections, etc., for all projects. In the future, proposals are to contain such control mechanisms. PCSIR top management is now delegating more complete authority to project managers. A project cost-accounting system is now being institutionalized. These programs were also instrumental in leading to the establishment of an industrial liaison unit at the Karachi Laboratories;
- It should be noted that, following his residency in Denver, the director of the PCSIR Karachi Laboratories initiated in Pakistan a program to encourage establishment of private R&D consulting firms. Two such firms are expected to be in operation by the end of 1976. The motivation of the PCSIR director was stimulated by realization of advantages to both government and industry by the presence of private R&D firms, which also removes the onus of government or industry being required to seek technical advice and counsel from PCSIR.

5. Staff Development

One PCSIR senior staff member is completing an M.B.A. at the University of Denver and has received one year (fte) of training at DRI in research operations and management. Upon return to PCSIR, the trainee will assume the post of Manager of the Industrial Relations Unit.

Twenty people at PCSIR have received some training in the conduct of techno-economic surveys of R&D underway in PCSIR.

Twelve people are currently involved, either full- or part-time, in industrial liaison. It is anticipated that the industrial liaison staff will increase to approximately 25 by late 1977.

Training for nine staff members of IIT has been completed in: information services and data banks; environmental controls, technology and pollution controls; quality control and inspection of foods and textiles; manufacture and quality control of antibiotics.

- IIT has initiated, with Colombian Government support, a study of the pollution problems/solutions of Cartegena Bay, patterned after the activities underway at Galveston Bay;
- IIT has expanded and increased technical information services to industry;
- IIT is promoting, with the local Squibb Pharmaceutical Laboratories, a program to assist in drug and antibiotics quality control;
- IIT is expanding its already considerable involvement in food technology to include the development of food processing systems that will provide nutritional foods for both rural and urban poor (utilizing simple equipment, inexpensive packaging, processing, restructured meats, other foods, etc.).

6. Techno-economic Surveys

Two techno-economic feasibility studies have been completed at PCSIR. These are: the recovery of magnesium and potassium chemicals from the liquor (bitterns) remaining after salt has been precipitated from sea water by solar evaporation and the processing of edible but waste "trash fish" into soluble fish protein concentrate (FPC).

As a result of these surveys, the Pakistan Government has provided funding for construction of an FPC pilot plant and is considering the funding of a bitterns pilot plant.

Training, as a side effect of this activity, has been noted above.

7. Technology Workshops with IIT

Two DRI-IIT-ANDI industrial seminars have been conducted in Colombia. The first was directed towards packaging, with 120 industrialists in attendance. The second seminar focused on ferrous and non-ferrous foundry practices--sixty industrialists attended.

The involvement of ANDI in these seminars is significant inasmuch as IIT and ANDI have had little prior interaction. Continued attempts are being made to encourage and strengthen the IIT-ANDI relationship which can materially enhance IIT interaction with Colombian industry.

IIT is proceeding with the organization, within IIT, of a small group in foundry technology which will be available to solve industrial problems identified during the foundry seminar. Similarly, a packaging capability is being established. ANDI has asked IIT to establish a packaging laboratory in Medellín and presumably will provide the necessary funds. Such a laboratory will be the first attempt of branch operations by IIT. If successful, other branch operations in the several disparate geographical areas of Colombian industrialization would be encouraged so that IIT could achieve even closer interaction with the industrial sector.

8. Technical Assistance to IIT Management

An IIT "Committee for Expansion and Diversification" has been created, consisting of the IIT director, four sub-directors, two senior staff members, and a DRI representative. The objective of the committee is to gain a thorough understanding of the Colombian infrastructure which has a potential for supporting R&D. The results to date have been marginal, but the activity is continuing.

9. Technical Services to PCSIR and IIT

Technical services provided by DRI have included:

- Guidance on converting agricultural wastes by fungal fermentation into animal protein supplements;
- Transmission of alternative energy source interests of ERDA which might be investigated in Colombia and/or Pakistan;
- Collaboration with U. S. EPA to establish environmental programs in PCSIR, utilizing PL480 funds (PCSIR, with DRI assistance, has submitted four proposals to EPA which apparently will be funded);
- Collaboration with PCSIR in preparation of a proposal to provide technical services to identify, develop, test, produce and disseminate intermediate technology suitable for village-level operations in Pakistan to process sugar cane, oilseeds, and rice bran;
- Collaboration with IIT in preparation of a proposal to provide technical assistance to a program of evaluation of the construction of small farmers' access roads in Colombia;
- Purchase and delivery of a wide variety of scientific materials and supplies on specific request by IIT. IIT has difficulty obtaining U. S. dollars so that a revolving account has been established which permits rapid purchase of required items with subsequent repayment by DRI staff members, who draw down pesos for local expenses while on duty assignments in Bogotá. No contract funds are involved in this service.

10. Intensive Technical Assistance with PCSIR

DRI and PCSIR are providing "intensive technical assistance" to two small chemical firms (paint pigments and industrial chemicals). In cooperation with the managers of these firms, PCSIR staff visit each firm frequently, seeking problems which confront the firms. DRI also attempts to visit each firm from time to time and provides know-how information and other technical data which are assisting these firms to improve their productivity and quality of product.

11. Technical Information Service

DRI conducted a computer literature search for IIT on "utilization of wood wastes." Over 50 references were provided to IIT.

Ninety-two patents on spray and tray/cabinet dryers were obtained from the U.S. patent files for possible use by the paint pigment manufacturer in Pakistan being provided intensive technical assistance. These patents were evaluated by DRI as to technical feasibility and forwarded to PCSIR who will work with the paint pigment manufacturer in developing an optimum dryer design for the company's use.

Information has also been provided to PCSIR on: sources of suppliers of electrodes for nickel-cadmium batteries; design data and specifications for equipment to be used in construction of the PCSIR FPC pilot plant; rice dryers, grinders and deboners; capacitor manufacturing; fungal fermentation of agricultural wastes; and information on marketing and/or economic data and pilot plant data on production of magnesium and potassium salts from bitterns.

12. Industry-Oriented Grants

The grant to IIT for recovery of cresylic and napthenic acids has been delayed due to a one-year delay in completing negotiations for a contract with Proquimsa to obtain the caustic wastes necessary to complete pilot plant runs. Laboratory data have been obtained in the interim, however, completion of the grant has been delayed by approximately eight months.

ICAITI has successfully completed its grant for the reduction of gossypol in cottonseed cake to be used for animal feed, and is negotiating with several feed formulation and cottonseed cake-producing firms to initiate commercial utilization of the process.

The FIIR grant on substitution of locally grown barley for imported wheat in the production of beer has been substantially delayed due to non-delivery of two items of equipment (the principal use of grant funds was for equipment) which are necessary to conduct pilot plant studies. The process has been demonstrated to be feasible in the laboratory. FIIR has finally received one piece of the equipment and is purchasing the other item with its own funds. Completion of the grant is not anticipated until one year after the equipment is installed.

Similarly, the ASRCT grant on use of rubber seed oil as a paint vehicle and dryer has been delayed by delays in obtaining equipment provided under the grant and the resignation of the principal investigator. Grant completion is now scheduled for May 1978. However, ASRCT has obtained the cooperation of a Thai paint firm and is utilizing small quantities of ASRCT-produced stabilized rubber oil in the company's paint formulations on a trial basis.

KIST has successfully completed its grant for substitution of up to 40 percent of locally grown barley for imported wheat used in the manufacture of pastry, breadmaking, and pasta. Of particular importance is the fact that this success by KIST can materially affect Korea's foreign exchange and simultaneously have a significant impact on rural income.

V. CONTINUATION OF CONTRACT ACTIVITIES

Most of the activities which have been described in this report (and in the final report for Contract AID/CM/ta-C-73-21) will be continued under the new contract (AID/ta-C-1337). For purposes of reference, the contract statement of work is repeated here.

A. Statement of Work (Contract AID/ta-C-1337)

1. Objective

The objective of this contract is to assist selected lesser developed countries'(LDC's) industrial research institutes (IRI's) in improving their organization, management, marketing and technical skills toward increased participation in the development of their country and to disseminate the results to IRI's worldwide.

2. Specifics

The contractor shall provide technical assistance as described below to selected LDC institutes and shall provide monitoring and follow-up of all grants previously awarded to LDC institutions and entities. The contractor shall:

a. Conduct six regional workshops for the training of LDC industrial research institute (IRI) managers. The workshops shall utilize

previously developed training materials and shall emphasize the role of host LDC institutes in the organization and conduct of the workshops. The training shall include perspectives on labor-intensive technologies, technical assistance for small-scale industry and the economics of small producers. The workshops shall take full advantage of the outputs from Contract AID/CM/ta-C-73-20.

Initial workshops shall be held in Tunisia and Thailand. The other four workshops shall be held in countries mutually agreed upon by AID and the contractor and shall include selections from:

- Central America/Caribbean,
- Central West Africa, and
- South America excluding Brazil, Venezuela, Ecuador and Argentina.

b. Finalize and publish a handbook to assist the conduct of research management training activities by LDC institutes. Disseminate the results of the workshops to IRI's and USAID's in selected countries.

c. Develop and implement a program of grant awards designed to promote more effective interaction between the IRI's and the R&D user community and to increase LDC skills in the preparation of research agreements, evaluation of project success probabilities, negotiation of R&D contracts and the generation of project ideas consistent with the capital/risk limitations inherent to their locale. The grant awards shall emphasize the user community including grants and technical assistance to user entities. To the degree possible, these awards shall include mechanisms which will provide IRI services to rural industries and small entrepreneurs through such groups as cooperatives, small industry associations and industrial estates. In no event shall grants be given to IRI's unless there is direct and continuing interaction with the user community in the prosecution of the grant.

Grant awards shall be based on a three-step process. Informal discussions shall be held with potential grantees, users and IRI's, in a number of countries. The selection of countries and institutions to be contacted shall be based on recommendations by regional bureaus and AID Missions. Formal requests for proposals shall be issued to those institutions expressing interest which are

judged to have adequate capabilities. Proposals shall be evaluated by a selection board and awards made on criteria which shall be provided following execution of the contract. Country-specific factors are anticipated to be in such criteria. A formal grant document signed by the recipient institution shall precede transfer of funds.

The number and dollar value of the grants cannot be predicted in advance and decisions shall be made on a case-by-case basis. However, the advance written approval of the Contracting Officer is required, with concurrence from TA/OST and the regional bureaus, prior to grant execution, announcement and disbursement. The contractor shall be responsible for the monitoring and reporting of LDC activities carried out under the grants. Total grant awards shall not exceed $200,000.

d. Continue assistance activities to two previously linked IRI's (PCSIR/Pakistan and IIT/Colombia) and negotiate and establish linkage with a third LDC IRI. Assistance to linked institutes shall include:

- Staff development through in-country training courses for IRI staff, in-residence training programs at the contractor's site for selected senior staff, and continued advice and consultation.
- Provision of a technical information response capability for specific inquiries from linked IRI's and their clients.
- Development of a technical outreach system designed to provide contact with and services to industry with emphasis on small-scale industries and rural enterprise. The target group(s) shall be identified through surveys of small industries, an assessment of priority needs and an analysis of IRI response capabilities. A service to provide problem definition, technical information, training and technical assistance shall be organized at linked IRI's using wherever possible existing elements of the institute. The contractor shall assist the IRI's in developing a cohesive and operational service with appropriate fee scales and ongoing evaluation methods.

- Technical consultation, advice, and support on specific problems of interest to IRI's and their clients. These technical assistance activities shall be based upon formal and documented requests from linked IRI's.

e. In all of the foregoing the contractor is urged to be cognizant of the environmental impact of R&D carried out by the IRI's under the terms of this contract. Assistance to the IRI's in conducting environmental assessments of project-related activities is encouraged. The contractor is also urged to expand the participation of professional women in achieving professional recognition and advancement. The surveys of small industries should endeavor to include information gathering on the role of women in the industries studied. To the extent possible and practical, prioritization of small industry problems and the assistance provided shall take account of the need to advance the role of women entrepreneurs and women employees.

3. Reports

An annual progress report covering all project activities shall be submitted by the contractor. The contractor may supply interim reports as he deems appropriate.

The annual report shall include summaries of the workshop activities and grant reports and be prepared in 50 copies; ten copies to be distributed by DRI to selected TA/OST contractors and 40 copies to be supplied to AID (TA/OST).

The draft workshop handbook shall be sent to AID (TA/OST) for review and comment on or before June 1, 1977. AID shall have 30 days in which to provide comments. The approved handbook shall be printed in 150 copies to be distributed by the contractor to LDC institutes, USAID's and domestic institutions. A distribution list shall be provided by AID (TA/OST).

APPENDIX A

COLORADO SEMINARY
UNIVERSITY OF DENVER
DENVER RESEARCH INSTITUTE
UNIVERSITY PARK • DENVER, COLORADO 80210

Office of International Programs

MEMORANDUM OF UNDERSTANDING
7 September 1973

TO: Dr. I. A. Akinrele
Director
Federal Institute of Industrial Research
Lagos, Nigeria

FROM: James P. Blackledge, Associate Director

SUBJECT: FIIR-DRI Linkage

The purpose of this memorandum is to summarize our discussions initiated in Lagos in March of 1973 and continued during the last month in Denver relative to the establishment of a long-term linkage between the Federal Institute of Industrial Research and the Denver Research Institute.

It is apparent that such a linkage should be built around and upon specific programs of mutual interest which will assist the FIIR in achieving an increased awareness of methodologies and rationale for more effective interaction with industry and to provide backstopping and assistance to FIIR as it continues in its structuring of research and development goals and programs designed to provide priority support towards the needs of industry. The general goals to be sought will include:

- Increased transfer of FIIR research results into industrial utilization,
- Increased industrial financial support of FIIR research projects and related activities,
- Increased recognition by the Institute of relevance of research programs to national, public and private sector needs, and
- Increased participation by FIIR in early phases of public or sector planning for development of new or improved processes or products.

Within the broad scope of the above goals, the following specific tasks and projects appear to be important for implementation during the next one to two years:

1. Training opportunities for FIIR staff in Denver in special topics such as technology transfer methodologies, working with small

industry, program planning and budgeting, market development, promotion, proposal preparation. These training programs would be conducted jointly with representatives from other linked research institutes in order to share experiences and initiate a program of inter-institutional interaction.

2. Joint research participation in specific projects which FIIR has identified as important to industry including conversion of agricultural wastes to protein, characterization of Nigerian clays for various commercial applications and in order to reduce current high tonnage imports of such materials, the development of electronic components from indigenous materials to supply the requirements of the growing electronics industry.

3. Collaboration in presentation of special technical conferences (for example, industrial fermentation) for the appropriate industrial sector.

4. Collaboration with the technical staff of FIIR in identification of barriers and constraints to innovation in Nigeria.

5. Serve as a plug-in point to the FIIR for the U. S. Data Banks on Technology.

Funding for some of the above projects is available under a current contract with the U. S. Agency for International Development. In some cases (for example, specifically relating to joint research participation), it will be necessary to seek additional funding from other sources which may be Nigerian industry or government or a variety of international agencies. It appears that there are several opportunities for such funding which can only be definitized upon completion of specific research proposals.

An additional area in which DRI could provide assistance if funds are available is that of augmentation and expansion of FIIR's industrial economics unit. Objectives within this specific program area could include providing technical assistance to FIIR to assist the Institute in (1) drawing the attention of Nigerian industry to FIIR services and the selling of industrial economics and other technical services to industry; (2) the continuing self-analysis of FIIR capability to undertake industrial problems; (3) provide marketing studies, operations research, systems analysis, backstopping; (4) assist in the build-up of staff competence in Lagos and other regional sites throughout Nigeria who could provide field services to identify problems and return these to FIIR for execution.

In the above program, we would visualize a series of people from DRI spending time in Lagos for various periods of time rather than one individual over a long-term period.

JPB:bb

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Office of International Programs

MEMORANDUM OF UNDERSTANDING
28 September 1973

TO: Professor Dr. Tarik G. Somer, METU

FROM: James P. Blackledge, Associate Director

SUBJECT: Preliminary Agreement on Linkage

Pursuant to discussions held in Denver on Tuesday, 25 September 1973, and under terms of existing contracts between DRI and the United States Agency for International Development, the following basis for establishing a linkage between METU and DRI is proposed. These types of joint efforts are recognized as being only typical of what may be accomplished as a consequence of the linkage, and do not in any sense indicate a requirement on the part of either institution, but simply reflect the types of interaction which appear appropriate; specific interactions will be the subject of prior definition and agreement on the part of both organizations.

Background

In his letter of 26 July 1973, Professor Blackledge presented to Dr. Süha Atamer of METU an outline of a general program of cooperation which DRI proposed to enter into with the Applied Research Center (ARC) of METU under terms of its contracts with the United States Agency for International Development for the provision of various types of assistance to industrial research institutes in selected countries. In his letter, Professor Blackledge noted that it is believed a fruitful relationship could be established with METU/ARC in view of that organization's purposes and qualifications. Subsequently, Professor Dr. Tarik G. Somer visited DRI on 25 September 1973, and discussions were held resulting in agreement to develop a preliminary relationship in accord with the principles set forward in Professor Blackledge's letter.

This memorandum is a preliminary statement of intent on the part of both institutions to enter into such a relationship.

Illustrative Types of Interaction

The following are seven types of interaction and cooperation which might be affected; they are not intended to be definitive or to preclude variations, but simply to be illustrative of the sort of linkage programs that may be anticipated.

1. Assistance in Research Projects

DRI, through its resources, could provide technical assistance in the form of qualified staff to participate in selected specific research projects resulting in more effective utilization of technology by Turkish industry and by strengthening the relationship and effectiveness of METU/ARC with that industry. Such a program might include joint surveys by ARC and DRI of research needs on the part of Turkish industry, as a preclude to specific programs.

2. Technical Information Services

DRI, as a consequence of its various programs, is in the process of developing a system which will yield technical information in response to inquiries from its several linked institutes and to serve as a medium of communication between these institutions and appropriate sources of technical and other information in the United States. As a consequence of linkage arrangements with DRI, the METU Applied Research Center could participate in this network and contribute to its programs as they are evolved.

3. Technical Symposia for Industry and Government

DRI may work in cooperation with METU/ARC in organizing and presenting appropriate technical symposia in Turkey for audiences comprising concerned individuals in industry, government and the academic community. Generally, such symposia would have an underlying purpose to improve the rapport of the Applied Research Center with its clientele. The subject matter would probably be of a technical nature and would require extensive involvement of the Center's staff, supplemented as appropriate by participation and other arrangements provided by DRI.

4. Research Colloquia

DRI has scheduled colloquia in Denver for participants from the other linked institutions. The first of these tentatively is to be held in February 1974 and the theme will be the relationship of the industrial research institute with small industry; a later program is to be held on the subject of "Mechanisms and Methodologies for Technology Transfer;" additional colloquia will follow.

5. Management Seminars

A program of interaction between linked institutes on various non-technical subjects relating to the management and administration of these institutions will be forthcoming. Thus, various interactive programs may be established involving the subjects of finance, accountancy, personnel, marketing, legal and contracts, and planning. For example, it is contemplated to hold research institute-specific training symposia on the marketing of technical research services, including the preparation of proposals, public relations, project development organization, etc.

6. Consortia

Already in effect within a group of five widely dispersed research institutions is a joint research and proposal development program relating to the use of fungi for the conversion of agricultural wastes to animal feedstuffs. This program, based on spin-offs from space-related technology and research, is pioneering in an area of new uses of natural processes for production of high-protein animal food from organic waste, with the beneficial side effect of reducing environmental pollution. It requires both sophisticated, advanced research techniques, and also highly individualized research and applications relating to the adaptation of the technology in particular local situations. For this reason, it is especially well-suited for utilization by a consortium of research institutions having the requisite technical and specialized knowledge of locales.

This type of approach, i.e., the grouping together of industrial research institutes from a variety of locales, has added appeal because of the appreciable knowledge which will be gained as to the mechanisms, problems, difficulties and rewards of multi-institution joint efforts of this type. It is, of course, anticipated that a METU/DRI linkage would provide good opportunity for initiation of this type of inter-institution program.

7. Research Grants Program

As alluded to in Professor Blackledge's letter, METU/ARC will be asked to participate in a DRI-administered grants program (soon to be announced), affording opportunity to secure dollar funding for selected technology adaptation projects in Turkey. This is, we feel, a particularly interesting new program in which the Center will be interested.

8. Financial Aspects

Through its contracted programs, DRI is able to finance many of the dollar costs incurred in such cooperative efforts described above. Typical

expenses which can be met are:

- Transportation, subsistence and administrative costs for linked institution personnel visiting the United States.
- Provision of United States experts to participate in joint research projects.
- Organization and presentation of symposia and training programs, both in the United States and abroad.
- Provision (within limits) of technical and other information in response to requests from linked institutions, and for the development of information systems.
- General administrative costs of the programs.

Next Steps

The following are proposed next steps toward the structuring of a linkage relationship:

1. During his visit, Dr. Somer speculated that it would be useful to have a METU/DRI team conduct a survey in Turkey of attitudes of industry toward the role of the industrial research institute and industry's utilization of technology, overall. Such a survey would be primarily useful to DRI in gaining an appreciation of the special conditions which obtain in Turkey, but would also have significant benefits for METU in its own efforts to develop its sponsor relationships.

Therefore, it is proposed that preliminary planning include this concept, with the objective of implementing such a research survey program at an early date.

2. On several occasions over the past two years, DRI has been host for various periods of time to research administrators from IRI's throughout the world. Each of these programs has been designed specifically to fit the needs and interests of the visiting management personnel and has involved symposia, informal technical discussions, extensive interactions on problems of research management, formal coursework at the University, program planning and preparation, and itineraries of visits to industry and other institutions in the United States.

It is suggested that METU consider which of its senior management staff might benefit from a program of visitation of this type, including identification of particular interests, so that further plans can be made.

3. Donald D. Evans, Assistant Director, Office of International Programs, will be available and in the Middle East region in November of this year; it is suggested that he spend two or three days at METU for purposes of familiarization and further development of the concepts of this linkage program.

4. Professor Charles S. Barrett, an eminent metallurgist on DRI's staff, will be in Turkey from September 30 to December 15. It is suggested that he visit METU for purposes of determining common research interests with interested metallurgy faculty and staff.

If this general plan of procedure meets with your approval (and the plan involves simply an agreement to further pursue these subjects of mutual interest), then an appropriate METU official will respond, indicating his institution's agreement and make such other comments or modifications desired.

JPB:bb

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Office of International Programs

MEMORANDUM OF UNDERSTANDING
1 December 1973

TO: Dr. Norton Young L.
Director
Instituto de Investigaciones Tecnológicas
Bogotá, Colombia

FROM: James P. Blackledge, Associate Director

SUBJECT: IIT-DRI Linkage

The purpose of this memorandum is to summarize our discussions initiated in Denver in August of 1973 and continued in Bogotá during the early part of November relative to the establishment of a long-tern linkage between the Instituto de Investigaciones Tecnológicas and the Denver Research Institute.

It is apparent that such a linkage should be built around and upon specific programs of mutual interest which will assist IIT in achieving an increased awareness of methodologies and rationale for more effective interaction with industry and to provide backstopping and assistance to IIT as it continues in its structuring of research and development goals and programs designed to provide priority support towards the needs of industry. The general goals to be sought will include:

- Increased recognition by the Institute of relevance of research programs to national, public and private sector needs;
- Increased participation by IIT in early phases of public or industrial sector planning for development of new or improved processes or products;
- Increased transfer of IIT research results into industrial utilization; and
- Increased industrial financial support of IIT research projects and related activities.

Our discussions have revealed that, in order to achieve these goals, several specific training and technical assistance projects must be initiated through the IIT-DRI linkage. These include: staff development, communications and interaction with industry, joint research of mutual interest, management and administrative guidance and counsel.

During the next one to two years, primary emphasis will be placed on training of IIT's four sub-directors to assume principal responsibility for all aspects of IIT promotion, identification of new or needed research areas, interaction with industry, knowledgeability about industrial and economic needs of Colombia. These new responsibilities will entail decreased emphasis by the sub-directors on internal administration, thus younger people will be promoted to assistant sub-directors and receive training in administration, management, and development of IIT's four divisions.

In addition, various specific training programs for younger staff members will be established on a variety of topics which will relate to increased ability by IIT to interact with the public and private sectors.

We have agreed that the following specific tasks and projects will be initiated as rapidly as IIT staff availability, IIT priorities, and funding constraints will permit.

1. Internal Management Development Program to Strengthen IIT Interaction with Industry

Each sub-director will be assigned principal responsibility for one of the following areas and receive specialized training at DRI as well as other U. S. locations where expertise is available. The areas and probable training sites will be:

- Industrial Promotion and Program Development (DRI, Midwest Research Institute, Southwest Research Institute),
- Identification and Evaluation of New Opportunities for Industrial Investment (DRI, Colorado Investment Corporation),
- Diffusion of Technology and Industrial Seminars (DRI, Technical Applications Center-University of New Mexico, NTIS), and
- Technical and Legal Aspects of Export Market Stimulation (National Bureau of Standards, Department of Commerce, Council of the Americas).

One of IIT's senior project leaders will also receive training at DRI in research institute administration and management, in order to assume these responsibilities in IIT at an early date.

We have agreed that you, as Director of IIT, should attend the workshop in Denver on coupling with industry, scheduled for late February or early March of 1974, and remain for an additional one to two weeks to explore and evaluate DRI policies and procedures for professional staff motivation, long-range planning, entry into new areas of research, etc., followed by brief visits to Midwest Research Institute and Southwest Research Institute.

A new permanent "Committee for Expansion and Diversification" will be created, consisting of the four sub-directors. Their duties and responsibilities will be to identify, assess and evaluate potential new areas for IIT involvement or expansion of existing areas, and make recommendations for action to the IIT Director. A DRI senior staff member will serve as technical advisor to the Committee.

2. Specific Short-Term Training in Selected Topics

Complementary to the above training, a series of short-term training (two to four weeks) needs are visualized which will contribute to professional staff development and increased awareness of this staff regarding the variety of industrial experience required for full participation in problem-solving for the industrial sector. Implicit in these short-term training programs will be the requirement that each IIT participant will present seminars to IIT staff and others on what he has learned during his training and to continue the learning process in his subject area.

IIT staff selections will be based on experience as well as anticipated future assignments of the individual.

DRI will seek opportunities for these specialized types of training orientation in categories to include but not be limited to the following:

- Technology assessment,
- Legislation and technical procedures for quality inspection of imported goods,
- Evaluation of labor-intensive industries in the U. S.,
- Identification of imports into U. S. having high-labor content,

- Availability of usable but obsolete (for the U. S.) equipment,
- Industrial sources of information,
- Orientation in industry manufacturing high nutritional value, low-cost foods,
- Sub-contracting opportunities to U. S. industry, and
- Orientation in improving efficiency and lowering costs of marketing.

Additional funding will be required for travel, per diem and other U. S. costs in order to activate this phase of the linkage.

3. Special Topic Workshops in Bogotá

DRI is prepared to present, in the near future, three workshops to IIT staff in Bogotá which we have agreed are important to staff development, increased efficiency of IIT operations, and improved relationships with industrial clients. These workshop topics are:

- Program Budgeting and Project Cost Controls,
- Proposal Preparation and Sponsor Promotion, and
- Research Data Evaluation, Report Preparation and Presentation.

These workshops are visualized as being approximately one week each in duration and will include formal lectures, individual staff consultation, joint participation in solution of current, actual IIT problems in the workshop areas.

Additional funds will be required to support these workshop in Bogotá.

4. Program to Stimulate R&D in Industry

DRI will assist IIT in developing a program of encouraging Colombian industry to utilize more R&D services internally. The scope of this program follows:

- IIT will send its staff to selected industries for short periods of time to help these identify their technical or management problems.

- IIT will arrange to undertake the problem-solving within the industry facilities if possible, although initially it may be necessary to utilize the facilities of IIT. In either event, however, a representative of the industry will be directly involved, for training and gaining experience in solving the problem and to strengthen relationships with IIT.

- IIT will attempt to organize an R&D, quality control, or troubleshooting unit in these industries, separate from production or maintenance.

- IIT will work toward creation of IIT-industry laboratory linkages whereby IIT will serve as a source of information, reference laboratory, technical assistance, etc.

- Industry would be expected to pay for such services, although initially some subsidy may be required.

5. Joint Research of Mutual Interest

We have agreed that, with the exception of our joint program on conversion of agro-industrial wastes to animal feed which is already underway, joint research efforts will be focused on other than food technology research and development. As such projects develop and appear to be of mutual interest, funding will be sought from a variety of sources to provide the technical assistance required and to support the research or developmental activity.

6. Plug-In to U. S. Data Banks on Technology

DRI, as a consequence of its various international programs, is developing a system which will yield technical information in response to inquiries from its several linked institutes, and to serve as a medium of communications between these institutes and appropriate sources of technical and other information in the United States. IIT will be encouraged to participate in this network and will receive technical assistance as required in identification and assessment of technological data which is important to and needed for IIT programs.

7. Colloquia, Workshops, and Management Seminars

DRI will schedule in Denver certain programs from time to time relating to research institute operations and management, technology transfer, etc., for representatives of the several institutes linked with DRI. IIT will be included in this program and its representatives will be encouraged to participate as a part of continuing IIT staff development.

The above-referenced projects are considered important to establishment of a linkage between IIT and DRI. Of course, these will be subject to change or redirection as required in order to achieve our mutual objectives. We have agreed that both IIT and DRI will exert their best efforts to accomplish the principal goals of this program, within the limitations of staff availability and funding limitations.

I realize that you must discuss the implications, potential benefits, extent of probable cost sharing, and other IIT commitments which would result from implementation of this program with your senior staff and your Board of Directors. If you and your colleagues concur in the contents of this memorandum and the outlines of our intention to establish a strong and viable IIT-DRI linkage, I would appreciate your advising me at an early date.

I look forward to the establishment of this linkage in fact, which we have discussed in principal over the past several years, and to working with you to accomplish these goals which I feel will be mutually beneficial to each of our institutes.

JPB:cjd
cc: Henry Arnold, USAID/Washington
William Ellis, USAID/Bogota

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MEMORANDUM OF UNDERSTANDING
1 March 1974

TO: Dr. M. Aslam
Director, Karachi Laboratories
Pakistan Council of Scientific and Industrial Research

FROM: James P. Blackledge, Associate Director

SUBJECT: Karachi Laboratory-DRI Linkage

The purpose of this memorandum is to summarize our discussions in Denver during the month of February 1974 relative to the establishment of a long-term linkage between the Karachi Laboratory of the Pakistan Council of Scientific and Industrial Research and the Denver Research Institute.

It is apparent that such a linkage should be built around and upon specific programs of mutual interest which will assist the Karachi Laboratory in achieving an increased awareness of methodologies and rationale for more effective interaction with industry and to provide backstopping and assistance to the Karachi Laboratory as it continues in its structuring of research and development goals and programs designed to provide priority support towards the needs of industry. The general goals to be sought will include:

- Increased recognition by the Laboratory of relevance of research programs to national, public and private sector needs;
- Increased participation by the Laboratory in early phases of public or industrial sector planning for development of new or improved processes or products;
- Increased transfer of the Laboratory research results into industrial utilization; and
- Increased industrial financial support of Karachi Laboratory research projects and related activities.

Although principal emphasis will be directed toward the activities and needs of the Karachi Laboratory, it is obvious that beneficial side effects of this linkage will accrue to other Laboratories of the PCSIR system.

Our discussions have revealed that, in order to achieve these goals, several specific training and technical assistance projects must be initiated through the Karachi Laboratory-DRI linkage. These include: staff development, communications and interaction with industry, joint research of mutual interest, management and administrative guidance and counsel.

During the next one or two years, primary emphasis will be placed on strengthening and expanding the Karachi Laboratory Industrial Liaison and Economic Evaluation Group. A combination of short- and long-term training in Denver, workshops and seminars in Karachi, and DRI staff assistance will be used to accomplish these objectives.

We have agreed that the following specific tasks and projects will be initiated as rapidly as Karachi Laboratory and DRI staff availability, Karachi Laboratory priorities, and funding constraints will permit.

1. Interaction with Industrial Liaison and Economic Evaluation Group

   - As a training mechanism, a DRI expert will spend several weeks in Karachi, working with the staff of the Industrial Liaison Group in preparation of an "Economic and Market Potential of Bittern," a by-product of the solar salt industry. This study should lead to preparation of a proposal for design and construction of a pilot plant and subsequent developmental research supported by industry.

   - DRI experts will work with Karachi staff in identification and development of specific case studies about interaction between the Karachi Laboratory and industry, which will be useful in training programs for middle-management staff within the PCSIR system.

   - DRI will seek financial support for a two-year graduate training program which will provide an opportunity for a member of the Industrial Liaison Group to obtain a Master's degree at the University of Denver, as well as practical experience in institute management, adaptation of technology, interaction with industry, etc., in DRI.

   - Short-term training will be provided to one or two Karachi Laboratory Senior Scientists in industrial liaison and economic analysis techniques (possible in connection with other scheduled training programs).

2. Special Topic Workshops in Karachi or Lahore

DRI is prepared to present, in the near future, three workshops to Karachi Laboratory staff which we have agreed are important to staff development, increased efficiency of operations, and improved relationships with industrial clients. These workshop topics are:

- Program Budgeting and Project Cost Controls,
- Proposal Preparation and Sponsor Promotion, and
- Research Data Evaluation, Report Preparation and Presentation.

These workshops are visualized as being approximately two weeks each in duration and will include formal lectures, individual staff consultation, joint participation in solution of current, actual Karachi Laboratory problems in the workshop areas. Such workshops are visualized as being of considerable importance in middle-management training needed by the PCSIR.

In connection with these special topic workshops, DRI experts will be available for additional time to assist the PCSIR in its reorganization into multi-functional, mono-purpose research institutes.

Additional funds will be required to support these workshops.

3. Colloquia, Workshops, and Management Seminars

DRI will schedule in Denver certain programs from time to time relating to research institute operations and management, adaptation and exploitation of technology, etc., for representatives of the several institutes linked with DRI. The Karachi Laboratory will be included in this program and its representatives will be encouraged to participate as a part of the continuing Karachi Laboratory staff development. DRI has funds available to provide participant travel and per diem.

4. Specialized Training Programs

DRI will seek opportunities for specialized training in areas such as instrumentation, standards, corrosion, etc., for selected Karachi Laboratory personnel. Negotiations will be undertaken immediately with such laboratories as the National Bureau of Standards, etc., to ascertain availability of such training opportunities.

5. Joint Research of Mutual Interest

DRI will assist the Karachi Laboratory in identifying opportunities for sponsored research and development programs from organizations outside of Pakistan, either directly contracted or sub-contracted through DRI or a similar organization, particularly where the Karachi Laboratory has capability, facilities, and special expertise to undertake such programs. This phase would anticipate two-way flow of scientists and engineers to maximize the research effort. As such projects develop and appear to be of mutual interest, funding will be sought from a variety of sources to provide the technical assistance required and to support the research or developmental activity.

6. Pilot Plant Development

DRI will collaborate with the Karachi Laboratory in pilot plant design and development. It is anticipated that funding for such projects would be obtained in Pakistan (either through PL480 funds or Pakistan resources). Hard currency needed for imported equipment and expertise would be requested from external sources. Examples of pilot plant designs of current interest include: recovery of chemicals from bitterns, mini-production of urea and methanol which are essential for PCSIR researchers in the field of catalysts for agro- and petro-chemicals, etc.

7. Plug-In to U. S. Data Banks on Technology

DRI, as a consequence of its various international programs, is developing a system which will yield technical information in response to inquiries from its several linked institutes, and to serve as a medium of communications between these institutes and appropriate sources of technical and other information in the United States. The Karachi Laboratory will be encouraged to participate in this network and will receive technical assistance as required in identification and assessment of technological data which is important to and needed for Karachi Laboratory programs.

It is understood that in all of the above, DRI staff who may be visiting the Karachi Laboratory will be prepared to present specialized seminars to PCSIR professional staff to meet anticipated organizational, management, or technological needs which develop while the PCSIR is in process of organization.

The above-referenced projects are considered important to establishment of a linkage between the Karachi Laboratory and DRI. Of course, these will be subject to change or redirection as required in order to achieve our mutual objectives. We have agreed that both the Karachi Laboratory and DRI will exert their best efforts to accomplish the principal goals of this program, within the limitations of staff availability and funding constraints.

I realize that you must discuss the implications, potential benefits, extent of probable cost sharing, and other commitments which would result from implementation of this program with your senior staff and your Chairman. If you and your colleagues concur in the contents of this memorandum and the outlines of our intention to establish a strong and viable Karachi Laboratory-DRI linkage, I would appreciate your advising me at an early date.

I look forward to the establishment of this linkage in fact, which we have discussed in principal over the past two years, and to working with you to accomplish these goals which I feel will be mutually beneficial to each of our institutes.

JPB:bb
cc: Dr. M. S. H. Siddiqui, PCSIR
Henry A. Arnold, USAID/Washington
Joseph C. Wheeler, USAID/Pakistan
George McCloskey, USAID/Pakistan Desk