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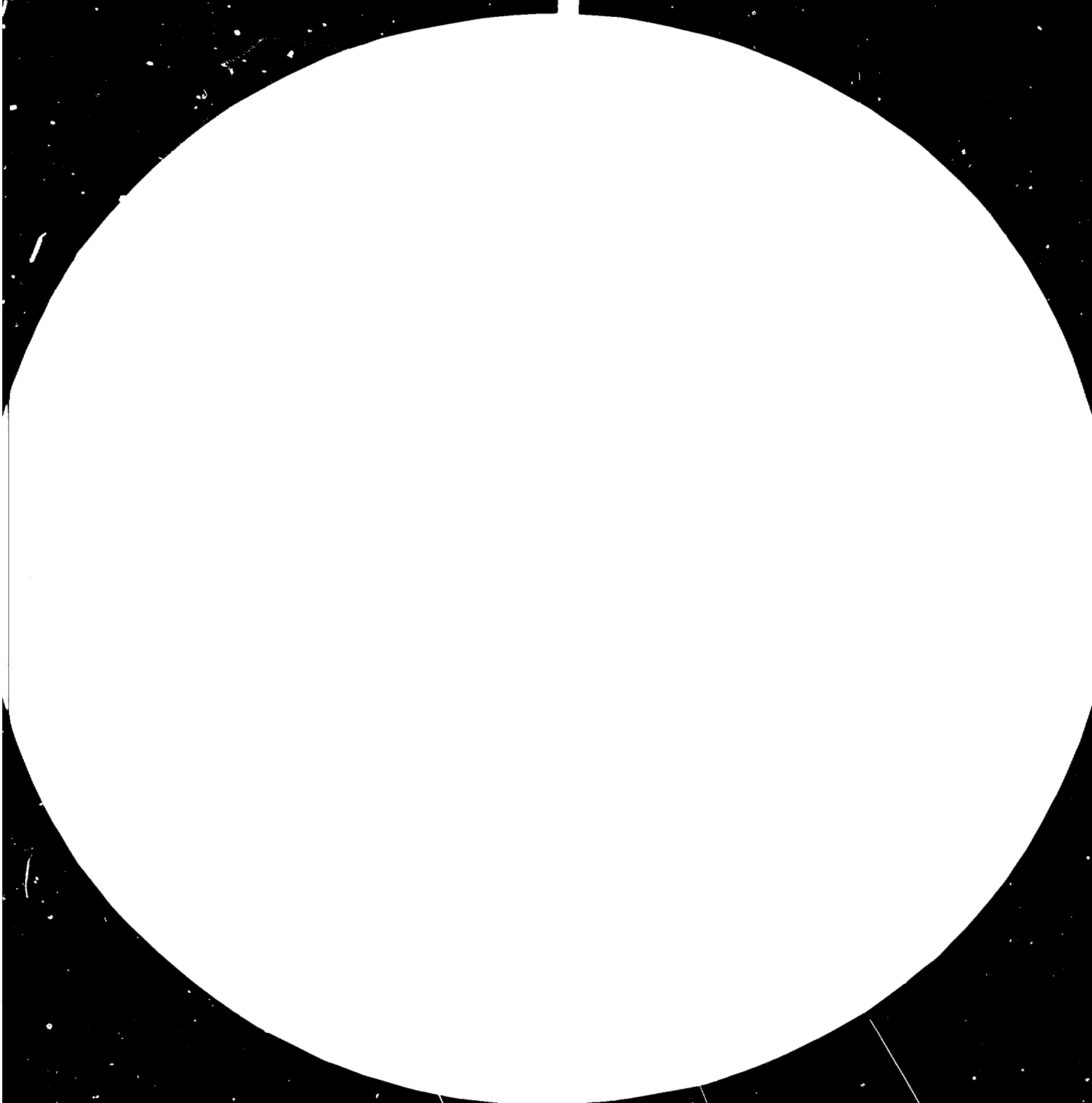

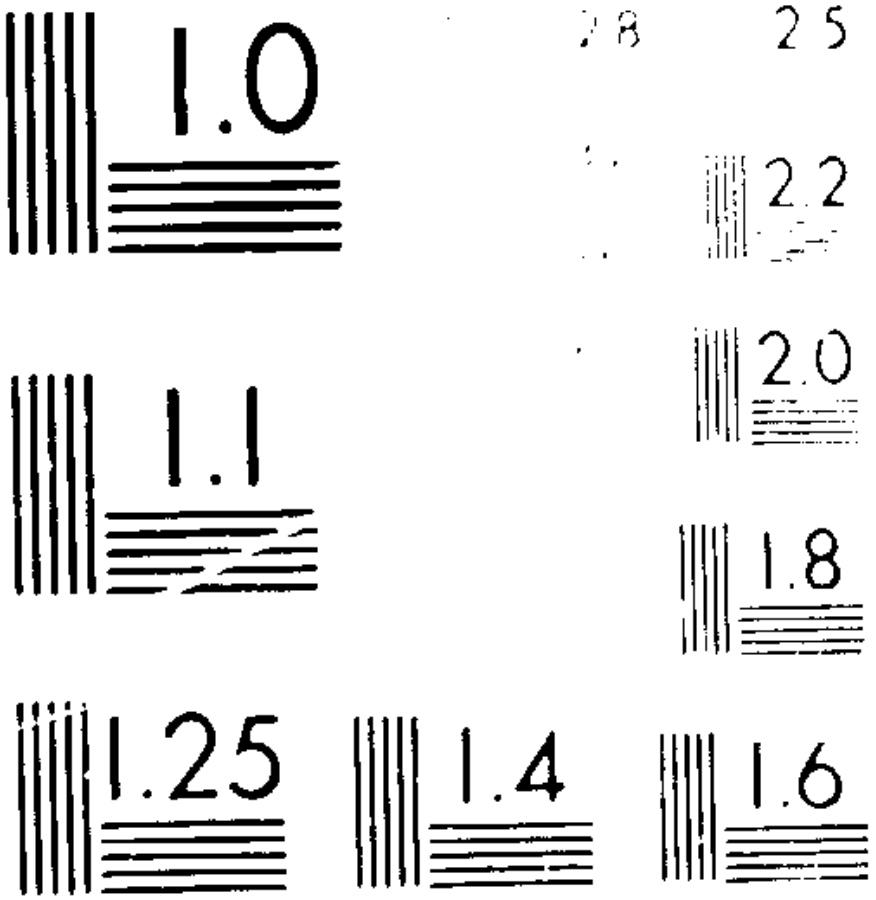
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UNIDO/EX.115
27 May 1980

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

ENGLISH

UNDP/UNIDO STAFF WORKSHOP

on

INDUSTRIAL RESEARCH AND SERVICE INSTITUTES

2 - 4 June 1980, Vienna

Role of IRSIs in National Strategies for Industrialization, Science and Technology Development *

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I. INTRODUCTION

1. The investment in the establishment of Industrial Research and Service Institutes (IRSIs) in developing countries during the past 20 years has been significant. The UNDP contribution for providing institution-building and technical assistance in about 100 IRSIs, since the inception of UNIDO in 1967, has amounted to approximately 55 million dollars (see annex in Staff Report of UNDP/UNIDO Evaluation Study of IRSIs). Perhaps 10 times that amount has been provided by counterpart government contributions, bi-lateral assistance, etc., during the early stages of the IRSIs' development. Since some of these IRSIs are more than 20 years old, and many more than 10 years old, and are largely government subsidized, there is no way of really knowing what the total investment has been to date.

2. The expectation was that these IRSIs would contribute in a material way to the national development process. While some IRSIs have been successful in this respect, experience and analysis have shown that many of these institutes have been marginal in their effectiveness, or have contributed little (other than provision of basic services) to industrial development.

3. There are a number of questions to be asked:

- Has this sizeable investment in IRSIs been worthwhile?
- What has been the real impact of IRSIs?
- What constraints and impediments have prevented effective IRSI operations?
- Have the governments recognized fully their own responsibility for IRSI support?
- Have the IRSIs been properly designed and implemented so as to achieve reasonable maturity and viability and to make significant contributions to their country's development process?
- Has the international and bi-lateral assistance extended to developing country governments for creating IRSIs been successful?
- Are IRSIs the best mechanism to achieve technological independence - are there alternatives?
- Is it possible for an IRSI to function properly in a developing country in the absence of a national plan for science and technology - a plan for industrial development - a complimentary and supporting infrastructure?
- How can IRSIs be designed or restructured in order to provide meaningful and useful services to government and to industry?

4. The UNDP/UNIDO Evaluation Study showed that, in many instances in developing countries, there has not always existed a clear perception of the roles of government, industry, and other elements of the industrial development infrastructure necessary to support and utilize effectively the new or existing IRSI. Insufficient attention was given to careful and thorough planning and design of the IRSI, both for the short term and the long term.

5. All too often, IRSI policy objectives, growth strategies, and functional activities were established, which related to traditional functions of IRSIs in advanced countries, but which frequently were not relevant to the development needs of the industrial public or private sector in the country of the IRSI. Liaison between IRSI and industry, between IRSI and government, between IRSI and other elements of the

development infrastructure, was shown to be marginal and vague in several cases, which imposed severe constraints on the ability of the IRSI to proivde useful assistance to the development process.

6. The effect of the above has resulted in IRSIs which, in many cases, are ineffective and which operate in a passive, rather than an aggressive mode. Their activities are focussed on supporting services to an appreciable extent; R+D activities are usually limited to "in-house" projects only occasionally related to national need. IRSI involvement in the technology transfer process has also been limited. The IRSIs seldom have sufficient autonomy to function in an effective manner. Rigidity of organizational structure and lack of management flexibility in making adjustments in operations needed to adapt to changing conditions of development, have often limited IRSI effectiveness. As a result, the IRSIs are frequently, and sometimes unfairly criticized by the potential users they were intended to serve.

II. THE IRSI AS AN ELEMENT OF THE DEVELOPMENT INFRASTRUCTURE

7. The IRSI, functioning in isolation from other elements of the development infrastructure, can really do little to further industrial development. All elements of the infrastructure must work together as a comprehensive industrial service support system. The system includes: government agencies; public and private industry sectors: the development banks; the universities; other technological institutions or specialized research institutes; and the IRSI. There must be a continuous dialogue between all elements of the infrastructure and full understanding of the responsibilities and functional activities of each of the elements.

8. It is incumbent on the government to provide the mechanism necessary to coordinate these elements. When designing an IRSI, the government and its advisors must recognize the possibility that existing R+D institutes may already be performing some of the functional activities also intended for the IRSI. Failure to do so will result in dilution of effort and inefficient use of scarce human resources. An example of lack of this will demonstrate how poor planning resulted in a marginal IRSI.

9. When the Government of Malaysia decided to establish an IRSI, a Government Standards Institute was already in existence and providing effective services. There were also several mono-purpose institutes - the Rubber Research Institute, The Food Research Institute, The Forest Research Institute, The Plastics Research Institute and specialized research departments in several universities.

10. The Government established the National Institute of Scientific and Industrial Research (NISIR) to promote, coordinate, and undertake scientific and industrial research which would benefit industrialization in Malaysia. NISIR's mandate was extremely broad, and conflicted in many instances with the vested interests of the other existing institutes, so that ultimately NISIR's activities required limitation and re-definition. NISIR has subsequently been reorganized, merged with the Standards Institute to become The Standards and Industrial Research Institute of Malaysia (SIRIM), and its activities directed to providing services to a limited number of industrial sub-sectors in Malaysia.

11. Governments in a number of developing countries have established coordinating mechanisms for their R+D institutions. These can be councils of Science and Technology or a similar organization. Unfortunately, councils of Science and Technology tend to place more emphasis on Science than on Technology. If this is so, then the government should redirect the Council's emphasis, or coordinate their industry-related R+D institutes with a governmental body specifically oriented to industrial development. Examples are:

- The Korean Institute of Science and Technology (KIST), which reports to the Minister of Science and Technology;
- The Pakistan Council of Scientific and Industrial Research (PCSIR), which is under the direction of the Minister of State for Science and Technology;
- The Institute of Technological Research (IPT), Sao Paulo, Brazil, which receives funding and guidance from the State of Sao Paulo Secretary for Industry, Commerce, Science and Technology.

12. Saudi Arabia is in the beginning stages of modernizing and expanding its industrial base. Several specialized R+D institutes currently exist in the country. Recently the Government created the Saudi Arabian National Council for Science and Technology (SANCST). The purpose of SANCST is to: (a) coordinate all R+D in the Kingdom; (b) stimulate R+D related to industrialization by grants and other financing; (c) establish a number of R+D institutes to focus on development needs. These institutes include, among others:

- an institute for arid lands research;
- an institute for environment and natural resources research;
- an institute for energy research;
- an institute for petroleum and chemicals research;
- an IRSI.

13. SANCST is now in the preparatory phase of designing these institutes. The question must be asked - what will be the policy objectives and functional activities for the IRSI which will not conflict with those of the other R+D institutes. Given Saudi Arabia's serious shortage of skilled human resources, SANCST must proceed carefully with its planning process. It is not clear at this point, exactly what the role of the IRSI will be in relation to the other proposed research institutes.

14. The important point is that there is recognition of the need for coordination and guidance at the highest levels of Government. In Korea and Pakistan, the Ministers of Science and Technology are members of the Presidents' cabinet. In Brazil, the Secretary for Industry, Science and Technology works closely with the Governor of the State of Sao Paulo, who is intensely industry-oriented. There are Ministers or Secretaries for Education, under which universities fall, but interrelationships between universities and R+D institutes are coordinated, not only at the ministerial or secretarial level, but also at the level of the university and the IRSI.

15. One of the most significant inputs from UNIDO to developing country governments contemplating design and establishment of IRSIs, is advice and counsel on the necessity for creation of a governmental Council, Ministry, or other body which will interact with, guide, and coordinate the functional activities of all R+D or specialized institutions within the country which relate, even indirectly, to industrial development.

III. THE IRSI AND NATIONAL POLICY DEVELOPMENT

16. An IRSI has the potential to make technological inputs to elaboration of government policy. As an example, exploitation of indigenous raw materials, environmental protection, and importation of technology, are nearly always subject to government policy, and the IRSI should be involved in the process of policy definition relating to these. In the absence of such technological inputs, governments may establish development policies which are counter-productive or which do not lead to technological independence.

17. An example common to a number of developing countries is the exportation of un-processed kaolin clay as a raw material, and subsequent importation of processed kaolin for sanitary ware, ceramics, etc. An alert IRSI can advise the government of the marketing, economic, and technological alternatives for in-country processing of kaolin, with high purity kaolin available for paper sizing and cosmetics, medium purity kaolin for industrial chemicals, and lower grade kaolin for local manufactures of ceramic products. From these considerations, government is in a better position to elaborate policies on importation and exportation of kaolin clay, and to encourage industrial development. The IRSI will also have a subsequent role in the development or adapatation of the technology for the industrial sector.

18. In the early days of the Central American Common Market (CACM), the Central American Research Institute for Industry (ICAITI) conducted a number of studies which provided guidance to the CACM Board of Directors relative to choice of industries, appropriate locations with respect to raw materials, transportation, labor supply, markets, etc. These studies included: installation of fertilizer and insecticide plants; feasibility of a steel mill in Central America; planning, modernization and expansion of textile factories; the market for sheet glass in Central America; exploitation of non-metallic minerals, etc. These studies not only assisted the CACM in reaching agreement between country government members, but also provided ICAITI with the background necessary to conduct additional studies and R+D both for the governments and for the industrial sectors involved.

19. The role of the IRSI in advising government on environmental protection policies is becoming increasingly important. Industry tends to resist restrictive policies on pollution controls. The IRSI, working with both government and industry, can provide assistance in conversion of industrial wastes into useful by-products or energy sources, treatment of effluents by microbial or other means to purify water supplies, etc. The IRSI should be able to develop standards, appropriate to local conditions, which will enable governments to impose realistic industrial pollution constraints, without arbitrarily restricting industrial production.

20. Again the example of ICAITI is used. A number of years ago, cotton growers in Guatemala used large quantities of pesticides to control insects, without an understanding of the amount really needed. The pesticides were subsequently found to contaminate fish and cattle in nearby areas. The ICAITI study showed that pesticide quantities used could be reduced considerably without decreasing insect control, but with correspondingly less contamination of meat and fish products. The study resulted in a control measure for the Government and a savings in pesticide costs for the cotton growers.

IV. THE IRSI AND NATIONAL DEVELOPMENT BANKS

21. Development banks need technical or techno-economic inputs for their evaluation and consideration of requests to finance development projects. Unfortunately, the IRSI is not often used to perform this function. The reason for this is not clear, but undoubtedly relates in part, to lack of understanding of the IRSI potential by the development bank as well as lack of aggressive selling by the IRSI. Here again, the government, or its coordinating entity must assure that continuous and extensive dialogue is maintained between the development bank and the IRSI.

22. When the U.S. Agency for International Development (USAID established a large science and technology loan fund with the State of Sao Paulo, Brazil in 1972, one intended element was interaction between IPT, The Institute of Food Technology (ITAL) and the Sao Paulo State Bank for Development (BADESP) to jointly provide assistance to industry. BADESP's administrative processes were so cumbersome that, even though several specific projects were identified, only a few were completed. IPT and ITAL gained experience in working with industry, but very little in terms of collaboration with BADESP.

23. ICAITI was asked by the Central Bank of the Dominican Republic to conduct a series of techno-economic studies in four industrial sectors of importance in the Dominican Republic: fats and oils; leather and shoes; metal-mechanical; and textiles. At the time of the studies there was not an IRSI in the Dominican Republic. Twenty-three feasibility studies were completed, of which nine resulted in establishment of new industries financed by the bank, and five studies are being considered for implementation based on economic and other conditions. The success of this venture subsequently led to the decision by the Government to establish its own IRSI.

V. IRSI - INDUSTRY RELATIONSHIPS

24. Unfortunately, there is little evidence to indicate that IRSIs are fully aware of industry's problems and actual needs. The technological assistance and services generally required by industry is in the following main categories:*

- Testing, analyzing and evaluating raw materials and intermediate products;
- Testing and analyzing finished products for standardization, quality control and certification;
- Specific information on the current state of world knowledge in industrial, technological and techno-commercial areas;
- Instrument repair, maintenance, and calibration;
- Designing equipment (e.g., simple ovens, kilns, mixers, and driers,;
- Trouble-shooting in industrial plants;
- Technical investigations to improve the quality of finished products and increase process efficiency;
- Developing new processes for current or new products at both the laboratory and pilot plant levels;
- Techno-economic studies;
- Engineering design and service work;
- Training of technical staff.

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* "Industrial Research Institutes, Organization for Effective Research, Technical and Commercial Services". UNIDO/IS10. 11/Rev. 1, 1975, p. 5.

25. Industry sector surveys to determine needs in the above categories should be a prerequisite for the initial planning, preparatory mission, and development of the IRSI operational plan and work program. Few governments and their IRSI advisors or management have conducted such surveys. Furthermore, it is not sufficient to send an expert to a developing country for two or three weeks and expect him to generate much more than a general overview of the nature of industry. Industry surveys must be in-depth, extensive, and continuous. The IRSI staff must be involved, not only to gain experience but to be in a position to compile composite statistics about production capacity, market potential and related data which can be invaluable aids to governments in the planning process and to industries as these seek to diversify or expand their product line. Industrial liaison and technical extension activities are a critical component of the IRSI operational methodology.

26. There are a number of ways in which to achieve effective industrial liaison and awareness of industrial needs. Before it was fully operational, KIST and its linked institute, Battelle Memorial Institute, conducted an in-depth survey of over 600 industries in 25 industrial sectors. This survey and subsequent analysis formulated the functional activities to be undertaken by KIST. The survey showed the level of existing technology as well as the potential for improved or new technology.

27. The industrial survey may show that the national industrial base is too low to support an appreciable amount of laboratory R+D and that IRSI emphasis should be devoted primarily to provision of basic services and techno-economic studies. As an example, the industrial base of the five Central American countries (population of approximately 20 million people), to which ICAITI offers services, consists of 5257 small, medium and large industries, distributed as follows:

SIZE/DISTRIBUTION OF INDUSTRIAL FIRMS IN CENTRAL AMERICA: 1977

	Small	Medium	Large	Total
Costa Rica	630	212	73	915
El Salvador	1263	448	187	1898
Guatemala	858	293	130	1281
Honduras	398	150	59	607
Nicaragua	350	137	69	556
Total	3499	1240	518	5257

Even though ICAITI has been operational for more than 20 years, its support for R+D continues to derive from 30 percent government subsidy, approximately 60 percent from government contracts, international agency or bi-lateral support, and perhaps as much as 10 percent from industry.

28. ICAITI has, however, maintained good industrial liaison vis-a-vis nearly 400 studies performed for public and private entities in the following categories:

- Market Studies
- Expansion, Modernization, pre-investment, and feasibility studies
- Regional Sector Studies
- Evaluations and Studies on processes, production facilities and installed capacity
- Valuation of fixed assets and techno-economic studies
- Geology and mining studies
- Others

Of the total, 31 studies were undertaken for the public sector, 163 for the private sector, 60 for development banks, 24 in other countries, 73 for regional and international organizations.

29. During the past 4 years, ICAITI has maintained resident technical extension agents in each of the five Central American countries. These field representatives have been the conduit for services to industry, provided on-the-spot by the field representatives, by ICAITI, or through local sources, in the areas of raw materials, process or product development, equipment specifications, etc., in the following categories:

	Information	Technical Assistance	Basic Services, R+D	Totals
Small	59	30	21	110
Medium	62	24	25	111
Large	28	6	14	48
	149	60	60	269

ICAITI does not fully recover the costs of this activity, but industry, through this mechanism, is increasingly aware of ICAITI and its capabilities.

30. KIST, IPT, and ICAITI regularly mail technical abstracts on a regular basis to industries, based on an understanding of interest and need. The National Technological Institute (INT) in Brazil established a similar service to about 4000 industries in 1974. The service was abruptly suspended in 1976.

31. In 1969, the Scientific and Technical Research Council of Turkey (TUBITAK) established an industrial relations unit which maintains contact with industry throughout Turkey. The Unit uses the technical extension approach. If possible, problems are solved on-the-spot, in one or two days time. If the problem is more complex or requires laboratory support, TUBITAK will contract with a university professor, or a R+D institute, or will request one or more of its own research centers to solve the problem. Information needs are referred to TURDOK, the National Information Center. Thus, the industrial relations unit of TUBITAK forms a sort of bridge between the industrial sectors with problems that need research and the research organizations. In 1975, more than 500 industrial problems were solved by this approach. The current situation is unknown.

32. The Government of Peru uses a slightly different approach. The Institute for Technological Industrial Research and Technical Standards (ITINTEC) was established in 1972 to promote, coordinate, orient, and execute industrial R+D in accordance with the policies for development and promotion of the Ministry of Commerce and Standards. ITINTEC is supported by a tax

assessment of two percent against all industry net income, before taxes, to finance industrial R+D projects.

33. The projects may be individual or collective, carried out by a company itself (or a group of companies), or these projects may be assigned to university or research institute laboratories, other public or private agencies or to ITINTEC. If the company, for a variety of reasons, does not use its tax credits to support R+D, the funds revert to ITINTEC which will utilize such funds in support of R+D programs relevant to Peru's national priorities and which may or may not related to the particular problems of the industry contributing the funds.

34. If the IRSI is not aware of industrial needs, and in the absence of clear direction and lack of industrial experience there is a tendancy for IRSI staff to develop R+D projects based on the fuzzy perception that there may be an end-user. Two examples will demonstrate the point.

35. A number of years ago, researchers of the PCSIR conceived the idea of producing a petroleum-based pesticide, then being imported into the country. PCSIR staff did not make a marketing or technoeconomic survey of the proposed process, but devoted approximately 10 years to laboratory experiments, application for patents, and construction of a pilot plant, with a considerable investment in time and effort. Only after PCSIR began to attempt to interest industry in the process did they learn that, due to a government subsidy on the imported pesticide, their process was not economically feasible and therefore of no interest to industry.

36. A similar experience of the Royal Scientific Society (RSS) of Jordan can be cited. The RSS established an Electronics Laboratory early in its operation, although without a clearly defined mission for the Laboratory. In the absence of clear directives, the Laboratory devoted four years gaining competence in the design and production of two-way radios for policy and military use, based on then existing technology and imported components. While the capability to produce the transceivers was established, RSS learned that the Japanese, U.S., and European technologies had been improved, the components required for the RSS transceiver were no longer produced, and commercially available imported transceivers were cheaper.

37. At the same time, based on its awareness of Korean electronics industry manufacturing capabilities and a strong market potential, both in Korea and for export, KIST used technology absorbed from Japan and the U.S. to develop a line of electronics devices - calculators, mini-computers, transceivers, etc., which are now being produced by Korean industry.

VI. THE IRSI AND TECHNOLOGY TRANSFER

38. An IRSI, if properly oriented, can play an important role in the process of technology transfer. IRSI staff members have opportunities, through international symposia, technological journals, information data banks, and personal contacts, to remain reasonably abreast of technological developments. The IRSI may have established linkages with research institutes in more advanced countries who can provide inputs. The IRSI may lack specific know-how information, design or operating data, etc., but often

it knows how to obtain such data. Further, based on its knowledge of the local situation (raw materials, labor requirements, product or process needs), the IRSI is in a position to make positive inputs into evaluation of the potential and utilization of an imported technology. The IRSI may be able to suggest alternative technologies; at least it can gain experience in developing indigenous technologies.

39. It should be clear that an IRSI can make major inputs only into the technology portions of the process. Other non-technology parts of the transfer process are the responsibility of the government, development banks, and industry. Nevertheless, such technological inputs should be of considerable interest to the development banks who are called upon to provide loan funds for imported technology, and to industry who may otherwise learn that it has purchased an obsolete technology, one that is inappropriate, over-priced, or already available within the country or region.

40. Table I* summarizes the direct and indirect technology transfer functions which an IRSI can perform and those which it cannot or should not perform: It will be seen that the IRSI can make major contributions in the following areas:

(a) Providing information on desired technology;
(b) Identifying alternative technological possibilities;
(c) Techno-economic feasibility studies;
(d) Selection of technology;
(e) Identifying alternative technology sources;
(f) Providing technical services;
(g) Performing back-up R+D;
(h) Industry personnel training.

41. The UNDP/UNIDO Evaluation Study has shown that few IRSIs in developing countries are involved in the transfer and adaptation of technology to an appreciable extent. This may be due in part to lack of awareness of industrial needs, and in part to attempts to transfer technology that is not appropriate for existing needs. Further, in the absence of government constraints, industry generally prefers to buy already proven technology on a turn-key basis. The government needs to provide industry with incentives such as tax incentives and rebates, or use an approach similar to that of ITINTEC, to stimulate industry use of the IRSI in the technology transfer process.

42. If the IRSI is to be involved in the technology transfer process, there must be a perceived need for the technology and an end-user. The technology to be transferred should have already been proven elsewhere, be adaptable to local conditions, and be appropriate.

43. An example is the technology for explosively forming and cladding of metals which has been transferred into industrial use in Brazil. The U.S. Space Program developed the explosive-forming technology for sophisticated missile components, using contractors such as Martin-Marietta Company, the Denver Research Institute (DRI), and others. The technology was found to be particularly appropriate for cladding stainless to mild steel, brass alloys to steel, etc.

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* L. F. Biritz, UNIDO, Unpublished paper, "Industrial Research Institutes," December, 1975.

THE ROLE OF AN INDUSTRIAL R&D INSTITUTE IN THE TECHNOLOGY TRANSFER PROCESS

Table 1

TECHNOLOGY TRANSFER STEP	ROLE OF INSTITUTE
A. Information on Section of Technology:	
(i) obtaining and providing information on desired technologies;	(i) major responsibility: must maintain up-to-date technological information service;
(ii) identification of alternate technological possibilities;	(ii) major responsibility: ties in with (i);
(iii) techno-economic and feasibility studies	(iii) depending on responsibilities and capabilities of the institute; input can therefore be major or minor;
(iv) selection of the most desirable technology;	(iv) only technical and techno-economic inputs, ties in with (iii); legal and financial considerations outside the institute's responsibility;
(v) identification of alternate sources of the desired technology;	(v) major role: ties in with (i);
B. Obtaining and Introducing the Technology to be Transferred:	
(vi) acquisition of rights to technology and obtaining technology know-how, including the formulation and closing of all types of technology transfer and licensing contracts;	(vi) this is not a responsibility of R&D institutes, except to provide technical information during negotiations; ties in with (i) and (iv).
(vii) establishing physical facilities and factories;	(vii) not the responsibility of the institute;
(viii) absorption of transferred technology, i.e., training of staff and personnel using technology;	(viii) a major responsibility of R&D institutes; one key function is the introduction of new technologies through the institute's laboratories or pilot plants by demonstrating these to industry personnel, i.e., introduce the technology through training;
C. Maintaining, Supporting, and Further Developing Transferred Technology:	
(ix) providing technical services for the transferred technology;	(ix) a major responsibility of R&D institutes;
(x) carrying out R&D for improving and further developing the technology;	(x) a responsibility of the institutes;
(xi) continued training of industry staff and personnel;	(xi) a continuing responsibility, although not always carried out by R&D institutes;
(xii) maintain information surveillance in the field of transferred technology;	(xii) an important institute responsibility;

44. Stainless steel is not produced in Brazil. Brazilian industry currently does not have the heavy equipment necessary for roll-bonding large plates used in the chemical industries. Explosive cladding of thin stainless steel sheets to thick mild steel plates for corrosion resistance uses appeared to have a market.

45. IPT and DRI, through a twinning arrangement, conducted a survey of potential industry users of the process. DRI trained IPT engineers in explosive forming and assisted in the design of a facility for explosive forming. IPT initiated production of clad 1 meter by 3 meter plates to meet industry specifications. IPT also acquired capability to explosively swage condenser tubes into tube-headers, which is currently being used by several large Brazilian boiler manufacturers. An appropriate technology has been introduced into Brazil that meets an industry need.

46. The KIST experience in electronics has been mentioned earlier. KIST acquired the know-how, adapted it to local conditions and needs, and transferred the adapted technology to Korean industry.

47. A developing country IRSI twinning arrangement with an IRSI in a more advanced country is a good mechanism to undertake the transfer and adaptation of technology. The IPT-DRI linkage is an example. The two IRSIs working together, can bring to the transfer process an understanding of the technology as well as the conditions necessary to adapt the technology to local application. If an advanced country IRSI is involved in the process, local iddustry may have more confidence in the potential use of the adapted technology.

48. This collaborative approach can also be used between IRSIs in developing countries. As an example, Korea imports large quantities of fructose syrup for the food industries. Thailand grows large quantities of cassava from which the fructose syrup can be produced. KIST and the Thailand Institute of Scientific and Technological Research (TISTR), formerly ASRCT, are working with a Thai and a Korean industry as joint partners to produce fructose syrup from cassava starch, thus impacting on a marketable product and a new industry.

VII. ALTERNATIVES TO IRSIs

49. Mention has been made earlier to the necessity for interaction between existing and intended elements of the science and technology infrastructure. Such interaction is an important element of an IRSI growth strategy. If the government is cognizant of the capabilities of its indigenous technological institutions it can schedule use of these to provide needed functional activities while the IRSI is developing.

50. Table II portrays some of the strategic options that may be available in a developing country. It may well be that the government will elect to continue use of these alternatives even after the IRSI is established, in order to expand the base of services to industry. The approach also provides a mechanism for identifying staff training needs and facilities acquisitions. Also, as priorities are established and if these are greater than the capacity of the IRSI to provide services in all priority areas, use of the alternatives in Table II makes possible trade-offs in services by delaying some of the services to be provided by the IRSI.

TABLE II

Alternatives for Short-Term and Long-Term Growth

Functional Activities	Short Term	Medium Term	Long Term
Analysis, testing quality control, standards.	Government or commercial testing labs. Research Institutes.	Government testing labs. Research Institutes.	Government testing labs. Commercial testing labs.
Technical Information.	University Libraries. National Libraries. Services outside country.	Research Institutes.	Research Institutes.
Technical Extension.	Consulting Engineering Firms. Productivity Centers. Research Institutes.	Research Institutes. Productivity Centers.	Research Institutes. Productivity Centers.
Research & Development.	Universities. Contracts outside country. Other Research Institutes.	Research Institutes. Universities.	Research Institutes. Universities.
Training Graduate. Vocational.	Universities. Productivity Centers.	Universities. Research Institutes. Productivity Centers.	Universities. Research Institutes. Productivity Centers.

VIII. SUMMARY

51. The comments and examples in the above sections of this paper may help to demonstrate what an IRSI is and what an IRSI can do. The achievement of IRSI goals is largely dependent on the attitudes and actions of both government and IRSI management.

52. Government must take the steps necessary to coordinate IRSI activities with those of other technological institutions. The best way to do this is through creation of a council of similar body which overviews and guides these institutions, and which provides general direction.

53. Government should take the financial and legal actions necessary, through tax incentives, etc., to encourage industry use of the IRSI.

54. Government should assure that the IRSI is fully utilized in development of appropriate national policies which have a technology component, and encourage the development banks to use IRSI services.

55. IRSI management and senior staff must also undertake an aggressive role in the process. It is the responsibility of IRSI management to point out to government the activities and services it can perform and which are needed as part of the development process. The IRSI management must establish working relationships with other technological institutions. Effective and continuous liaison with public and private industrial sectors is imperative.

56. IRSI management and staff must recognize the nature of the services required by government and industry and focus their attention on these as a priority. Except for staff development and the long-term, R+D may well be a lower order of priority than techno-economic studies and basic services. The IRSI should be structured and staffed to meet these needs.