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RESEARCH/INDUSTRY LINKAGES - THE EXPERIENCE IN TURKEY 1/

by

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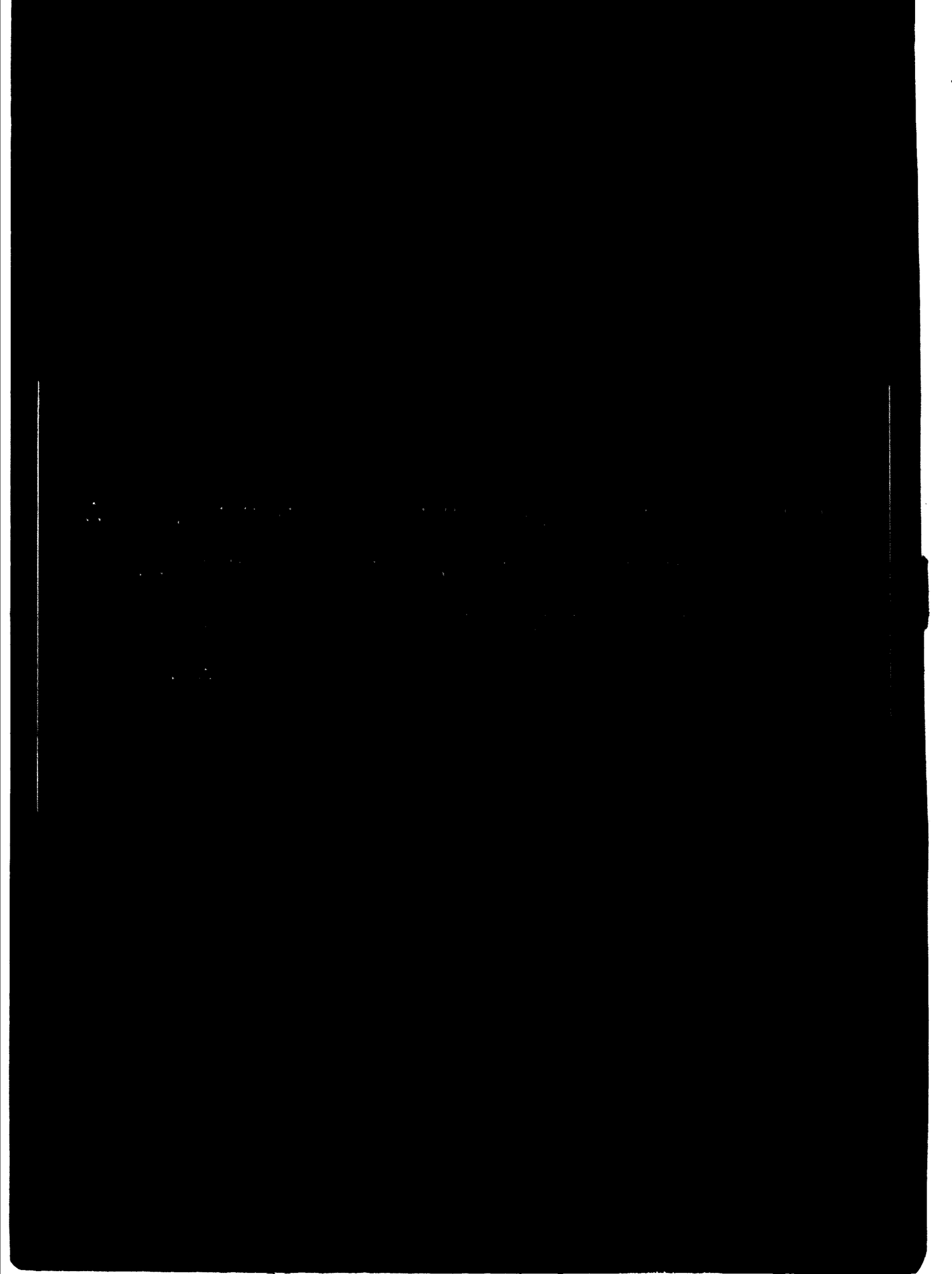

Some problems encountered in the forging of effective research/industry linkages and possible mechanisms to facilitate such co-operation are discussed in this paper, in the context of experience in Turkey.

The case of Turkey has special interest as the country is now moving rapidly from 'developing' to 'developed' status. To mention two criteria: per capita income in crossing the US $ 1000-mark and the share of industry in national product, presently around 24 per cent, is expected to overtake agriculture soon (it is planned to be four times that of agriculture by 1995).

However, the country's industrial technology establishment has not been adequate. There is a shortage of personnel for applied research work, and R and D expenditures as proportion of GNP have in fact declined in the last decade (to 0.35% in 1970). The 1975 National Plan document states: "The fact that a technology policy related to creation and application of appropriate technologies connected with intermediate and investment goods production and suited to the changing social structure of the country has not been put forward, creates bottlenecks".

At present, manufacturing enterprises, both state and private, do practically no in-house research and do not appear to be in close contact with technological innovations abroad. The technologies employed are often inappropriate or out-dated and this, together with sub-optimal size, has at times resulted in under-utilized capacity, high production costs and low product quality.

The Fourth National Development Plan now under preparation is expected to lay stress on science and technology. Clear S/T plans and policies are being formulated, with emphasis on strengthening technological self-reliance. A number of new research centres are in process of establishment and existing ones are being augmented. UNIDO has been involved in these efforts.

Problems in commercialization of research findings

It is now recognized that applied research is only the tip of the technology pyramid, resting upon a sound assessment of the market as foundation together with a broad base of product and process development, pilot operations, plant design, process adjustment and commercial operation including the technical services needed to sustain product competitiveness and the feedback of data for product improvement.

The obvious first step (and one often missed) is the survey of needs even before a decision is taken to set-up an industrial research institute (IRI). Based on such a survey, the IRI design could in many cases cover not only the technological aspects but those of economics and commercialization. It may be mentioned that in starting the Materials Research Unit at the Marmara Scientific and Industrial Research Institute, Gebze (near Istanbul), a UNIDO consultant was engaged to make a survey of research requirements to ensure that the facilities and programmes are demand-based and not supply-oriented.

The word 'research' in the name of many institutes has at times caused misunderstanding. They primarily (and quite logically) cover investigations to solve operating problems and provision of technical extension services, not 'pure' or 'applied' research but 'need-based' activities. This per force requires an even more intensive dialogue with their clientele.

It must be emphasized that research work has a high moment of inertia, and it is therefore essential to plan in advance. Research results which come too late or too early are wasteful of resources.

In Turkey, as in other countries, the commercialization problems are compounded at the conventional IRI by structural weaknesses such as the inability to recruit and motivate staff with industrial experience at government salaries, the lack of a business-like approach and the absence of effective communication with users. The inability to provide the total package of technical services together with some assurance or guarantee on the successful commercial-scale viability of the technology offered are additional deterrents.

These handicaps create a credibility gap. The local businessman would then rather import technology indiscriminately (or stick to antiquated methods in a protected market) rather than use the Government-sponsored IRI (or do some R and D himself). This in turn curbs innoviative talent and perpetuates the country's technological dependence. Government policies tend to encourage the import of equipment which brings much embodied technology with it; this tends to conflict with the need to stimulate local equipment manufacturing and indigenous research efforts.

Commercialization action by IRIs (1)

Most IRIs have a planning group and a research programme. But effective commercialization often depends on a (i) participation of both state sector and private interests in the advisory function, (ii) a flexibility in changing the project portfolio from time to time (background research to generate information; applied research on problems of national concern; product development and problem solving on contract basis; and ad-hoc research on emergent problems), and (iii) a system of project review and evaluation, guided by cost/benefit principles and by courage to drop inactive projects which are beyond resources or which cease to serve any useful purpose.

Ideally, commercialization action should start before the research results are available, with the identification of a sponsor who pays for the cost of the investigation. But in most developing countries the IRI's services are expected to be 'free' to tax-payers. This being so, at least a potential partner has to be found when the product or process looks feasible; if a pilot plant is essential it is best erected in the partner's factory using his staff, supplemented by

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(1) For a complete discussion see 'Guidelines for Development of Industrial Technology in Asia and the Pacific', 1976, by F.N. Woodward, R.D. Lalkaka and T.S. Chung.

IRI personnel. If this is not possible, then a 'demonstration plant' at the IRI itself might serve the purpose of 'selling' the idea, making the product available for customer tests and generating some operating/engineering data. An unconventional - but often effective - method is for the research workers who have developed a process to break away and set up a commercial plant themselves.

A major problem at another level is to effectively transfer research results and deliver extension services to small entrepreneurs, without an unduly large proportion being absorbed by the stronger firms who also have access to other technology sources.(2) Recent surveys confirm that over half the total clientele of a documentation or extension service is from the neighbourhood where it is located and the laboratory or its branch is best located close to the point of use. The Leather Research and Training Institute at Pendik, for instance, has had to open a field laboratory at Kazlicesme where tanneries are concentrated.

In addition to physical proximity, the personnel involvement of the end-user in the research task can be the soundest motivation. As an example, the 'three-in-one combination group' in China brings together various levels of experience in a task force - for instance, the steel mill worker, the technician and 'leading cadre' (the research manager) for investigations on a new metallurgical process; or the farmer, the manufacturer and chief engineer for improvement fo an agricultural implement.(3) There is also the 'sending-out-and-inviting-in' procedure whereby the scientist goes out to work in the factory and the shop-floor worker spends time in the laboratory. Variants of such mechanisms could be adapted to suit conditions in other countries.

Another example from Asia which might have relevance to other regions is the use in Indonesia of university students (the 'BUTSI') to spend part of their national service in rural areas as 'semi-specialists' for providing technical services on simple products and processess. A new collaboration project between the Institute of Technology Banding and the Foundation for Technical Development in Developing Countries (TOOL-Eindoven) will provide back-up services in the form of an information system on technology options, a hardware development activity to provide complete manufacturing instruction packages, and field stations for testing prototypes. A similar activity could be planned in eastern Anatolia in collaboration with TBTAK and involving university students.

Universities in Turkey, particularly Middle-East Technical University Ankara and Istanbul Technical University, are doing significant research.(4) In 1975 their research activity involved expenditures of TL 241 million (US $13 million) of which about 30 per cent was in industry-related areas. Much of this work is in such fields as computer programming, mechanical testing of materials and management studies. For instance, Instanbul University has an affiliated Institute of Business Administration while various departments of METU have set up research agencies on a contract by contract basis.

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(2) R.D. Lalkaka, Acquiring Technology for Metallurgical Industries, ESCAP/UNIDO, September 1976.

(3) S. Ishikawa, The Chinese Method of Technological Development - the Case of the Agricultural Machinery and Implement Industry The Developing Economics, Volume 13, December 1975, Tokyo.

(4) Naci Bor, Research Today in Turkey, TBTAK, October 1976.

There is now a Council for Industry-University Relationships under the joint auspices of Istanbul Technical University and Union of Metal-working Employers.(5) A more comprehensive association involving research institutes also might be usefully started by TUBITAK.

Instruments for commercialization

A useful device is the setting up of a promotional agency to "(i) license inventions derived principally from Government-financed research ... and (ii) make available development finance either to support further development of invention up to the stage of potential industrial interest, or to support joint development projects with industry".(6) Such an agency should have capabilities for independent assessment of technology, preparing feasibility studies and participating technically and financially in setting up projects, perhaps through a revolving fund.

The National Research Development Corporation of India and the Japan Research Development Corporation (JRDC) are good examples. The Korean Technology Development Corporation (KTDC) has been set up to commercialize work of the Korean Institute of Science and Technology (KIST) and is unique in that it will accept compensation in the form of equity participation in new enterprises based on KIST technology. It works closely with the Korean Development Financing Corporation, which is represented on the Board of KTDC. As R and D activities in Turkey increase the need for such a promotional body could arise soon.

The lack of design support to help commercialize IRI findings can be partly overcome by setting up engineering consultants. They can play a pivotal role in identifying needs, making techno-economic appraisals of new products/processes/ projects, scaling-up pilot scale results, engineering the complete plant and providing guarantees if required.

Turkey has adequate consultancy services in areas such as management and civil engineering. For minerals exploration projects, the Maden Teknik Arama Enstitüsü (MTA) provides comprehensive investigation services. Firms for project engineering in important sub-sectors such as chemical and metallurgical industries are only now being developed.

Ultimately the effectiveness of intra-country technology transfer depends upon dynamic technical leadership at the research institute, supported by sound business procedures. The transnational enterprises (TNEs) owe their power, among other things, to rapid technological innovation and its global transfer; the Government-sponsored laboratory needs to have the same strong relationships with its constituents within the country, as the IBM central laboratory has with its subsidiaries in different countries.(7)

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(5) See Sevka ve idare Dergisi, August 1976, special issue on industry-university linkages.

(6) Objectives of the National Research Development Corporation set up in the UK in 1948.

(7) A major criticism of the TNEs from the developing country viewpoint is in fact that practically all research is done at Headquarters and very little in the host countries.

UNIDO-assisted research in Turkey

UNIDO has a substantial involvement in strengthening industrial R and D efforts in Turkey. The current projects fall into well-recognized types of organizations, namely:

1. Autonomous state-aided multi-disciplinary institute	TUBTAK - Marmara Research Institute (Materials Research Unit)
2. Co-operative research institute	Cement Research and Development Centre, Ankara
3. State-organization operating mono-industry institutes	Textile Training and Research Centre, Bursa
4. State-controlled institute	Leather Research and Training Institute, Pendik (TAO with UNIDO)

During the UNDP Second Country Programme, 1978-82, two new centres are to be set up, for fertilizers and pulp/paper. Further, preparatory work is planned for R and D activities in the electronics industry, non-ferrous metals, and agricultural equipment prototype fields. Concurrently, specific research projects are to be assisted at the Minerals Research Institute (MTA) and the Forest Research Institute.

The point to note is that the institutes for cement, textiles and leather combine training and research under one roof. In this way inter-action between the two functions is facilitated and the available technical personnel are better deployed.

At the same time there are other UNIDO projects - the In-Plant Training Centre for Engineers where the primary emphasis is on non-formal, on-the-job training and the National Small Industry Development Programme, which will provide a wide range of advisory services to small industry plants.

Salient research/industry aspects of the research projects are indicated below.

Marmara Scientific and Industrial Research Institute

The Marmara Institute of TUBTAK at Gebze near Istanbul covers research on a wide spectrum of disciplines - food, electronics, operations research, mechanical and chemical industries. The Materials Research Unit (MRU) has been operational at Gebze since January 1973 and the UNIDO project started a year later. The original project document called for "emphasis on testing, trouble-shooting, quality control and development work for industry, not on basic research". In the last two and a half years MRU has established good linkages with industry and made significant contributions to advancement of metals extraction, production and fabrication.

In the second year of its operation (75-76), the unit has contracted and completed assignements valued at about US $500000. Typical of the projects undertaken are the beneficiation of calcined pyrite of Turkish origin, the prototype production of special copper electrode holders, silver-cadmium internally-oxidized contact materials and corrosion control of the new Bosphorus Bridge. In addition, work was carried out on several in-house projects such as a survey on local bentonite clays.

The significant feature of the Marmara project is that quite early in its life it has had fair success in its approaches to industry, based on the original survey of felt needs.

From the technical co-operation view-point also, this undertaking has some innovative features: it is the first project in this country to have a Turkish national as UNIDO Project Co-ordinator, in line with the New Dimensions of UNDP policy; the arrangement is working well. This project co-ordinator is also professor at the Istanbul Technical University: thus, scarce technical resources are fully utilized and the university/research linkage is strengthened.

Further, a significant twinning system has been established with a metallurgical research centre in Yugoslavia whereby the two institutes are now jointly undertaking the design and implementation of a comprehensive quality control system at a Turkish iron and steel mill. The provision of experts and arrangements for training are also being made mutually between the co-operating institutes.

In the next phase of the project, the Marmara MRU is to be assisted in diversifying to more sophisticated metallurgical activities, and a major cost-sharing in UNDP inputs has been agreed.

It may be mentioned that TUBITAK, which controls Marmara, a Building Research Laboratory and an Instrumentation Control Laboratory, has an Industrial Liaison Unit. This Unit seeks to identify research problems from industry and to pass on results through personal contacts, publications of research profiles and 'open-houses' for visiting industrialists.

Cement Development and Research Centre, Ankara

The state and the private cement mills (each producing about half the country's total tonnage) have joined hands to form a Cement Manufacturers Association. This in turn is now building the 'Cement Development and Research Centre' through per-ton levies on cement output.

The Centre has four sections - process control, raw materials, cement and concrete - as well as documentation and techno-economic study units. The long-range objective is to up-grade local skills for cement mill operations and undertake applied research on short-term and perspective industry problems.

This co-operative research, among the first of its type to involve both public and private producers in Turkey, may well be the appropriate mechanism for forging strong links between training, research and industry in other sectors, eg. fertilizers.

Another feature is that under UNDP/UNIDO auspices, bi-lateral support has been attracted to this project - the Federal Republic of Germany has agreed to provide inputs for the raw materials section and negotiations are under-way with other countries.

Textile Training and Research Centre, Bursa

The Centre, which was started in 1972 and has been assisted by UNDP/UNIDO since 1974, is now fully operational. At present, the bulk of its services are for Sumerbank, a large state economic enterprise established in 1933 which controls one-fourth of the country's textile industry. The Centre's main activities are:

- training: about 10 courses involving 400 persons annually on pilot equipment, in-mill courses and seminars as well as training of trainers.

- testing of yarn and fabric: for which the centre earns around $25,000/year from state and private mills.

- research and consultancy services: mainly periodical industry-wide surveys of yarn quality, problem-solving, standardization and control techniques, effluent treatment, etc.

- information activities including publication of manuals on mill operations and maintenance.

These types of research testing and training activities by a 'captive' laboratory for a single group pose no serious linkage problems. But the stage has come when the Bursa centre plans to strengthen and consolidate its facilities for more intensive and diversified services, not only to the state-group but to the whole textile sector in Turkey. To increase private industry participation, an advisory board has been proposed (with private and state mill members) to advise the centre's management. In this second phase it is also planned to set up a textile design section and an industrial effluent laboratory.

Leather Research and Training Institute, Pendik

To fully realize the attractive export potential of the leather industry in Turkey calls for improvements in quality of hides and skins, as well as production technologies and management. The Pendik Institute, under the Veterinary Department of the Agriculture Ministry and assisted by FAO/UNIDO, has the tasks of applied research investigations in common problem areas, training in specific skills, testing and extension services, pilot production of main leather types using a revolving fund, marketing and management assistance.

The difficulties of linkage with industry are particularly acute as most of the 15,000 footwear units are in small, dispersed ateliers with output of only 1 to 1½ pairs per worker per day (total output 35 million pairs/year, 80,000 workers). The garment industry consists of some 500 larger units (output 0.75 million garments, 30,000 workers).

As noted earlier, a field laboratory has now been set up right in the midst of the tanneries, so that they have rapid access to testing and advisory services and provide a feed-back on actual research needs such as purity of chemicals, effluent disposal and water supply problems. The UNIDO shoe-making expert and his counterpart have been spending a third of their time in going around the ateliers to provide on-the-site advice.

A research/industry linkage mechanism which has been working well at Pendik is the Advisory Board with 12 members including six from the Chambers of Commerce/Industry and the leather trade. UN representatives and project manager also attend. The Board's responsibilities are to help formulate programmed activities, review progress, initiate new schemes and generally stimulate good working relationships between the institute and all segments of the leather/leather product industries. The point to note is that the Advisory Board is now exercising some of the functions of a management committee, with increasing confidence and co-operation between the Government and private representatives.

Concurrently a working group of the Board is preparing proposals for giving the Institute a semi-autonomous status. The private units have agreed to share in the running costs and have themselves approached Government to impose a statutory levy for the purpose. Further UN assistance is now planned during which expert advisory services would be gradually phased out in order that the institute can be self-reliant.

A Role for UNIDO

The review above indicates the points where UNIDO intervention on reinforcing research/industry linkages in Turkey has been found useful. Some action for the future is outlined below.

The technical assistance requirements of countries at the development level of Turkey call for departures from conventional patterns into more innovative forms. Equipment supply components can in appropriate cases be reduced; expert assignments of long duration can partly be replaced by provision of short, high-level consultancies to transfer new technologies and to provide the global experience for national planners to take informed policy decisions.

Limited UN finances relative to needs also necessitate the mobilization of other resources to ensure achievement of project objectives - from bilateral donors, from Government's own cost-sharing, and by recourse to recruitment of qualified national experts and local consultant firms. UNDP/UNIDO in Turkey is playing an active role in using such new formulae to augment efforts towards the development and transfer of technology. Preparing and monitoring these complex arrangements places an additional - but welcome - load on the office of the Senior Industrial Development Field Adviser.

Training activities of UNIDO are required at two levels - for top management, often non-technical, to appreciate and use R and D facilities, and for middle-rung research workers to up-grade their skills for implementing tasks in a responsible manner.

UNIDO's role of promoting the synergy between research and industry is illustrated on a phosphate project, where it acts as 'go-between' in bringing the exploration/beneficiation agency and the fertilizer plant (which is to process the concentrates) together in order to formulate compatible specifications and pilot-testing programmes.

To facilitate intra-country transfers of technology more attention can be given to such devices as sub-contracting, both nationally and internationally, and the centralized purchases of know-how. For inter-country transfers, tripartite arrangements can be significant using say technology from the west, capital equipment from a socialist country, and the manpower and market of the developing country.

UNIDO could increasingly assist in the fundamental tasks of formulating national policies and plans on industrial technology, suggesting new forms of co-operative research based on the country's needs and aspirations, analysing the criteria and policy inducements for appropriate choice of technology, and developing the high-level manpower needed for the management fo technology transfer.

The sharing of experiences between developed and developing countries and among the developing countries themselves is being stimulated through action-oriented seminars, joint research projects, setting up of regional centres for technology development and transfer, publications in regional languages, and exchanges of technocrats. A forthcoming mission by a group of Turkish technologists to India, under UNIDO auspices, will pave the way for long-term co-operation to mutual advantage.

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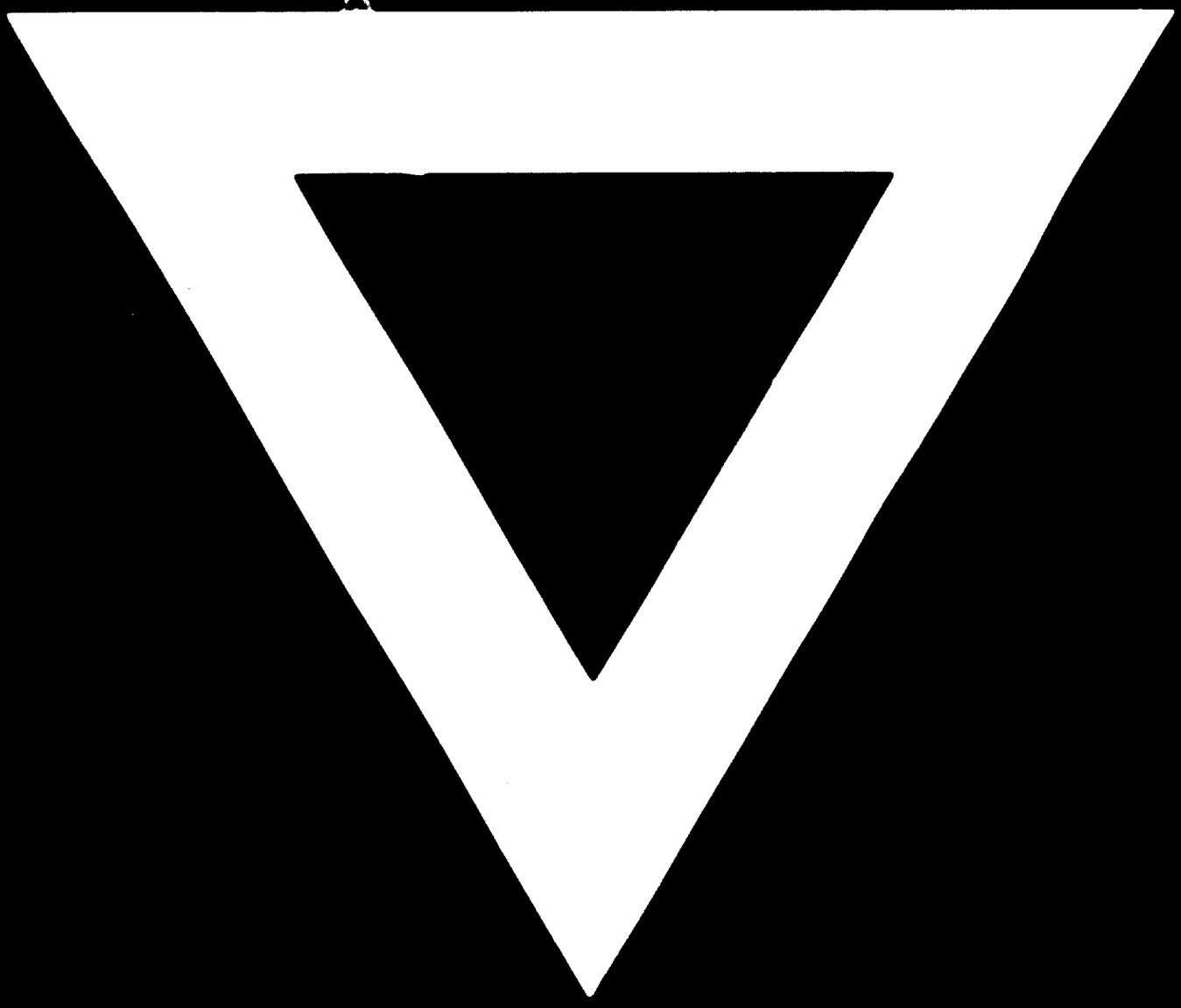

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