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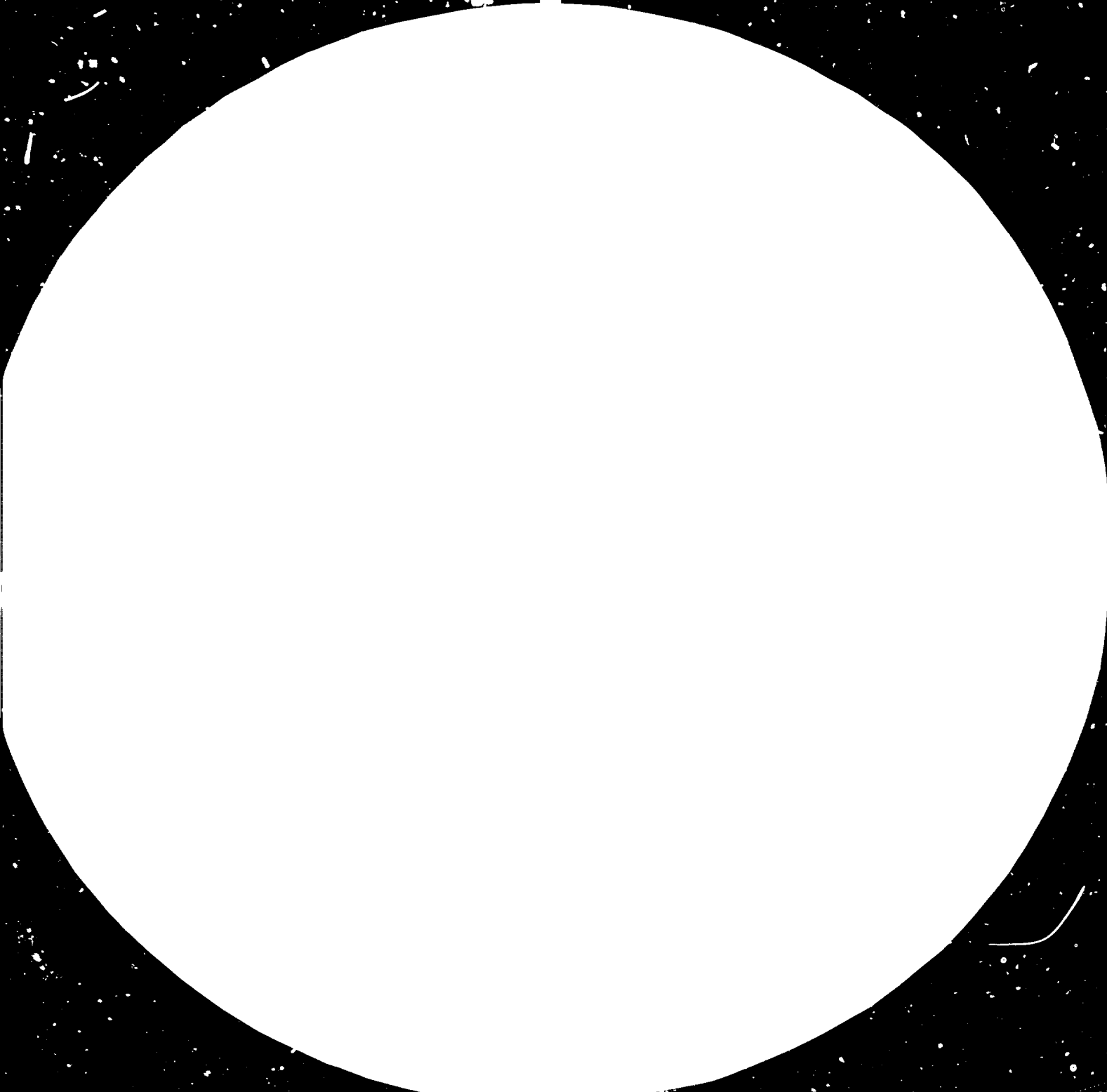


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UNIDO'S TECHNICAL ASSISTANCE TO THE MARMARA SCIENTIFIC AND INDUSTRIAL RESEARCH INSTITUTE, TURKEY

by

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1. INTRODUCTION

During the first quarter of this century, the fact that industrial development can be helped and stimulated by scientific and industrial research has been recognized by industrial management as well as by government authorities. There are many successful examples, especially in industrialized countries, proving this statement. However, industrial research and development is relatively new in developing countries, and offer services not too different from one country to another, since the goals of industrialization programmes are more or less similar; namely, more local manufacture, greater diversification of products, more efficient production and better competitive market position both at home and abroad. Since these countries face similar handicaps, research institutes are called upon to fill in similar gaps in the industrialization process. This is the rationale for the co-operation among the metallurgical research and development centres, and therefore for this workshop.

2. MARMARA SCIENTIFIC AND INDUSTRIAL RESEARCH INSTITUTE (MSIRI or MRI)

MRI is founded by the Scientific and Technical Research Council of Turkey (TOBITAK). The Council, which is connected with the Office of Prime Minister, owes its existence to a special law enacted in 1963. Science Board, which is the highest decision making body of the Council, decided in 1966 to set up a research institute to promote industrial development in Turkey, through scientific and industrial research. In 1968 research units were organized at Turkish Universities to form the nuclei of the future departments of the Institute. These were the Materials, Electronics, Industrial Chemistry, Nutrition and Food Technology, Applied Physics, Applied Mathematics, Operations Research and Mechanical Engineering Research Units. Until the Institute became operational in late 1972, these units made surveys of Turkish Industry, helped in the design of Institute buildings and laboratories, prepared specifications for the equipment to be purchased, and solved small problems of the industry by trouble shooting and consultation. When these units started

to move in to the newly built institute buildings first few years were occupied with the activities of commissioning of equipment and laboratories, cultivating industrial contacts, starting research projects both in-house and sponsored. Since then MRI developed very rapidly. Number of staff rose from less than 100 to more than 500. With the addition of new buildings closed office and laboratory area increased from approximately 4000 to 32000 sq. meters. Institute is multidisciplinary in its organization comprising six research departments in the fields of Materials, Electronics, Industrial Chemistry, Applied Physics, Applied Mathematics and Operational Research. Mechanical Engineering Research Department could not be started mainly because of financial difficulties. The objectives of the Institute set forth in its by-laws can be summed up as follows:

(a) To create competence in particular disciplines or interdisciplinary areas;

(b) To undertake research for the development of new materials, products, processes, methods, technological system, and management systems;

(c) To provide conditions for successful application of research findings;

(d) To provide general services to the industry;

(e) To train and educate research and technical personnel.

(f) To undertake all other work necessary for the scientific and industrial development of the country.

To achieve these goals the Institute has a matrix type of organization and works on project basis. In this system boundaries between research departments are eliminated and unification towards a common goal, which allows optimum utilization of resources, is emphasized.

Presently total personnel of the Institute is 520; out of which 160 are research staff with university degrees, 110 are research technicians and 250 are support personnel covering administrative staff of 50, construction and maintenance technicians of 45, service personnel of 85, the rest being comprised of central workshop technicians, drivers, and others.

3. MATERIALS RESEARCH DEPARTMENT (MRD) AT MSIRI

3.1. Establishment and Development of the Department

The Department was started in mid 1968 by the present speaker and the author of this paper. The staff before January 1973, when the present premises at Gebze were taken into service, was kept below 10. They were occupied with the industrials surveys, preparation of technical and architectural specifications for the planning and building of present department facilities at Gebze, ordering and purchasing of equipment.

While the Materials Research Department was housed at the Technical University of Istanbul as a guest unit, an application for technical assistance was made to the United Nations Industrial Development Organization (UNIDO) in 1971 and renewed in 1972. After a preparatory period of nearly three years this technical assistance became operational in 1974 within the framework of First Country Programme. With the inputs of both the Government and that of UNIDO the Department developed rapidly. The staff doubled in 1974 and reached 40 in 1975. With the addition of nearly 10 members during the each following year, this figure grew to 70 in 1978 when phase of UNIDO technical assistance continued into a second stage of five years with the inauguration of Second Country Programme, 1978-1982. Staff members reached its maximum of 90 in 1980, but receded back to 82 in 1981, due to political and economic crisis prevailing in those years. Out of those 82 members 37 are research staff with university degrees (10 Ph.D.'s, 21 M.S.'s and 6 B.S.'s) 40 are research technicians of various levels and 3 are secretaries.

Administrative work is taken up by the central administration of the Institute described above, in Section 2.

The closed area of the Department consisted of a four story theoretical studies and administration building of 1900 sq. meters surface area an da 5000 sq. meters standard laboratory building at the beginning. With the completion of a high bay building of 1600 sq. meters suitable for pilot plant type research, in 1975, closed area reached 8500 sq. meters. Presently two pilot plant buildings each of 500 sq. meters are under construction. When these buildings are taken into service in mid 1982, total area of the Department will be nearly 9500 sq. meters.

3.2. UNIDO Technical Assistance Programmes During the Development of the Department

After the brief description of MSIRI and MRD we shall take up the UNIDO technical assistance to MRD in detail and try to describe how it was instituted, managed and what were the results obtained, so far, with one more year to go, before it phases out at the end of 1982 along with the Second Country Programme.

First application for such an assistance was made in 1971 and renewed at 1972 at a new form. Project document was prepared by two UN experts and was scrutinized later by a third UN-expert. Technical Assistance programme was approved under the code number DP/TUR/77/020 in early 1974 and became operational with the arrival of first Project Manager Mr. G. Manning, from Battel Memorial Institute, Columbus, Ohio, U.S.A. The author of this paper being his counterpart as National Project Director. A novel feature of implementation in this phase was, after one year of operation, combining the responsibilities of UN Project Manager and National Project Director under a new, and honorary title of Project Co-ordinator. Thus Project Director continued the implementation of the Project on behalf of both UNIDO and Turkish Government. Total UNDP contribution to DP/TUR/72550 amounted, in its revised form, to $ 675,752.13. The first phase being brought to a

successful conclusion; Turkish Government (State Planning Organization), UNDP and UNIDO, encouraged the Project Co-ordinator to prepare a project document for a possible second phase technical assistance to be based on pilot plant scale research in the field of materials and manufacturing processes. This second phase was approved by the parties concerned as UNIDO Project DP/TUR/77/020, which was implemented by the present Project Co-ordinator, again honorarily, in January 1978. UNDP contribution in this phase is foreseen at $ 1.181.580.- The second phase is at its fourth year at present, and will phase out next year, at the end of 1982. Below the objectives, inputs, outputs, of both and first and second phase technical assistance programmes will be described in greater detail.

4. UNIDO TECHNICAL ASSISTANCE PROGRAMMES AT MARMARA RESEARCH INSTITUTE

As described briefly in paragraph 3.2. technical assistance was started in 1974 with a three year programme DP/TUR/72/550 which constituted the first phase, when a second phase programme DP/TUR/77/020 of five years was approved and became operational in January 1978. Total UNDP inputs for the first phase being $ 675,752.13 and for the second phase $ 1,181,580.- Thus total technical assistance forseen for the Materials Research Department is $ 1,857,332.13. Government inputs to these projects were TL 42,480,000.- and TL 150,382,000.- respectively. Below these projects are taken up separately.

4.1. UNIDO Project No. DP/TUR/72/550/I/01/37 Entitled "Assistance to Marmara Scientific and Industrial Research Institute, Gebze"

The long range objective of this project was "to provide a facility in Turkey to carry out technical services, trouble shooting and quality control for companies and industrial departments using, producing or concerned with industrial materials including plastics, ceramics, composit materials, metals and metal products". The immediate objectives was defined, in brief, as "to strengthen the operation of the Unit (i.e. Department) by the input of experience and instruction provided by international experts, by training of the

Turkish Scientists, by the input of equipment to be integrated to the facilities already provided by the Government of Turkey".

As with every UNIDO project three major components of this project are (a) Experts, (b) Equipment, and (c) Training. However, in this phase an important activity took place, in the, (d) subcontract component the final figures for expenditures in these components and their ratios in the total UNDP input are as follows;

(a) Experts	$ 116,169.88	17 %
(b) Equipment	$ 374,366.23	55 %
(c) Training	$ 42,175.19	6 %
(d) Subcontract	$ 124,460.00	18 %

Equipment provided in the first phase consisted of an automatic Erichsen sheet metal testing machine, Model 142-40, a high Frequency induction furnace, 100 kW solid state generator with three melting crucibles of 90, 60, 30 Kg steel capacities, a 100 tons Universal Testing Machine, a 20 tons electro-hydraulic servo-controlled close-loop MTS testing machine, a Hille "Experimental" Rolling Mill, fully instrumented, 2 high and 4 high rolls, 100 tons rolling load, for hot and cold rolling, a reheat furnace, 54 kW, open at both ends, maximum operating temperature 1280 ^{o}C, and a Peugeot 504 station wagon. Expert and consultant component amounted to 34.2 m/m's. Training component was used as "mission oriented", so that trainees were sent for short periods ranging from one to 4 months, to be trained in a particular process, technique or skill whihc was put into use at the Department immediately after their return. The sub-contract enabled the young Department to undertake a major project, in collaboration with Metallurgical Institute Hasan Brkic, Zenica, Yugoslavia, entitled "Improving tne Process and Quality Control System of Karabük Iron and Steel Works". The three year project started in the first phase continued into the second phase and resulted in a 666 pages final report in 6 volumes, which is under implementation presently. Karabük paid the equivalent of $ 350,000.- to MRD for this project. Another major project undertaken in 1975 by MRD was the "Beneficiation of Pyrite Calcines of Turkish origin", sponsored by Etibank for approx. $ 400,000.- Project

lasted 4 years and covered laboratory as well as pilot plant scale testing. This project is also at the implementation stage. Other achievements of this phase include "Prototype Production of Arc Furnace Electrodes from Cast OFHC Copper", "Silver-Cadmium Electrical Contact Material Development, "Non-Destructive Testing of Bosphorous Bridge", "Corrosion Control of Bosphorous Bridge", "Development of Dental Amalgams", surveys of "Turkish Bentonite Clays" and of "Turkish Foundry Sands". All of these research projects were 100% sponsored by industry. Besides these a few hundred applications from industry involving trouble shooting, testing, chemical analyses, and expertise were answered. In-house research concentrated in the fields of low-cycle fatigue and in-situ composites.

In order to perform these assignments, and to successfully conclude these projects, equipment, other than those supplied by UNIDO was needed. These were provided by funds given by Turkish Government.

Major equipment purchased with national funds are the following:

(a) Analytical Equipment: Scanning electron microscope equiped with wave-length and energy dispersive X-ray spectrophotometers, 100 kW transmission electron microscope, x-ray diffractometer and computerized x-ray fluorescense spectrophotometer, fully equiped DTA eqiupment, Absorbtion spectrophotometer

(b) Alloy Making Equipment:1 kg. steel capacity vacuum induction furnace, vacuum arc furnace for making alloy buttons, 500 kg steel capacity arc furnace, various crucible furnaces, electrical and fuel-fired, for non-ferrous alloys, various industrial size heat treating furnaces, etc.

(c) Equipment for Mechanical Shaping: swaging machine, 250 kg mechanical hammer, etc.

(d) Equipment for Measuring the Properties of Materials: 10 tons Instron machine, 40 tons hydraulic universal testing machine, Impact testing machines, magnetic properties, thermal properties, electrical properties testing machines, etc.

At the end of the first phase with the inputs of both the Turkish Government and UNIDO, Materials Research Department of MSIRI established itself in Turkish industry. There was a greater demand for its service than MRD could provide. During this period its staff grew 30 to 70. MRD matured into a well equiped and self confident research group.

4.2. UNIDO Project DP/TUR/77/020/F/01/37 entitled "Assistance to Marmara Scientific and Industrial Research Institute, Phase II

This project constituted the second phase of the UNIDO technical assistance programme. It mainly consisted of the following components

(a) Experts	$ 217,350.-	18 %
(b) Equipment	$ 679,194.-	57 %
(c) Training	$ 115,682.-	10 %
Total	$ 1.012,226.-	85 %

Equipment provided by UNIDO in the second phase consisted principally of a vertical 500 tons extrusion and impact forging press, a vacuum induction melting furnace with 40 kg steel capacity. Vacuum annealing furnace forseen in the project document could not be procured for lack of funds; as a result of rapid rise of prices and decline in the value of US Dollars in those years. However a locally made annealing furnace capable of working with inert gas atmosphere was used in its stead. Other equipment procured with national funds in this phase were a 10 meters long fully instrumented rotary kiln, pilot plant size equipment for a mineral beneficiation laboratory, machine tools, a fully equiped precision investment casting laboratory , etc. However, due to the foreign exchange crisis prevailing during the second phase no equipment could be imported with national funds, and only locally manufactured equipment could be purchased for the project. During this phase Metal Founding Division of MRD initiated in 1979 a UNIDO Training Project entitled "Small Scale Foundry Operations Group Training Programme"; which was in its third year in 1981. It was designed for and well received by the candidates from the Third World.

Major sponsored and completed research projects undertaken during this phase by the end of 1981 are the following: "Prototype production of four machine parts by precision investment casting and design of a production plant for investment casting" for the largest Machinary and Chemistry Concern (MKEK) in Turkey, for a 100 % sponsor budget of TL 47 000 000 (which is equivalent to US $ 360,000 at the present exchange rate); "Development of production Technology of alloys used by the Turkish Mint" (TL 3,986,000); "Development of metal friction surfaces to be used in the breaking systems of airplane and heavy machinary " (TL 4.300.000); Development of Aluminum Bronz and Brass castings for arc furnaces" (TL 2,310,000); "Survey of Turkish forging industry" (TL 350,000); "Development of production technology for torsion suspension bars for heavy vehicles" (TL 295,000); "Establishment of quality control laboratories for GLI-Works" (TL 575,000); "Cladding of Aluminum base bearing materials on steel backs" (TL 408,300); "Production of tool steel dies for MTE-industries " (TL 2,450,000), and others. Industrial services in NDT, chemical analyses, mechanical testing, consulting, and trouble shooting involved several hundred assignments each year. In-house research include "Laboratory scale production of pure silicon", Development new investment casting techniques using indigenous raw materials", "Direct Reduction of iron ores", "Nodulization of Manganese ores", "Recovery of valuable metals from Copper anode slimes", "Notch effect in low cycle fatigue", "Effect of ductile-brittle transition in low-cycle fatigue", "Process control techniques for vermicular iron production", "Development of high-temperature in-situ composites", and others. Above titles for both sponsored, and in-house projects indicate the wide range of research capability created at MRC, in a relatively short time period of 7 to 8 years, with the inputs of Turkish Government and UNDP/UNIDO. A comparative UNDP/UNIDO evaluation of the UNIDO Technical Assistance to Marmara and 7 other UNIDO assisted Metallurgical research establishments the World over, was performed in 1978. The results of this comparison was very favorable for the Marmara Research Institute, indicating a performance of the first order. Recent Economic and political crises in Turkey which reached its climax in September 1980, also took its tall on the UNIDO technical assistance programmes.Strike threat of research workers in 1980, prevented implementation of training and

expert components in 1980 and also in 1981. As a remedy for this situation remaining funds in these budget lines were transfered to subcontract budget line; to allow a twinning arrangement with a larger research institute, in order to continue along the already opened path of successful implementation in bringing the second phase to its conclusion at the end of 1982.

5. CONCLUSIONS

5.1. UNIDO Technical Assistance to Marmara Research Institute in Materials Research has succeeded in creating an industrial research capability and accompanying technological self-relience in this area.

5.2. A novel feature in the implementation was the combining of the responsibilities of the UN Project Manager with that of the National Project Director, under the title of National Project Co-ordinator. This arrangement works well if this person is allowed a freedom of action within the framework of the project document.

5.3. The political and economic conditions prevaling in a country strongly influences technical assistance programmes.

5.4. Two factors play a decisive role in the success of a UNIDO technical assistance programme. These are (a) establishment of a close rapport with the indigenous industry, and (b) co-operation between countries of comparable development levels within such assistance programmes.