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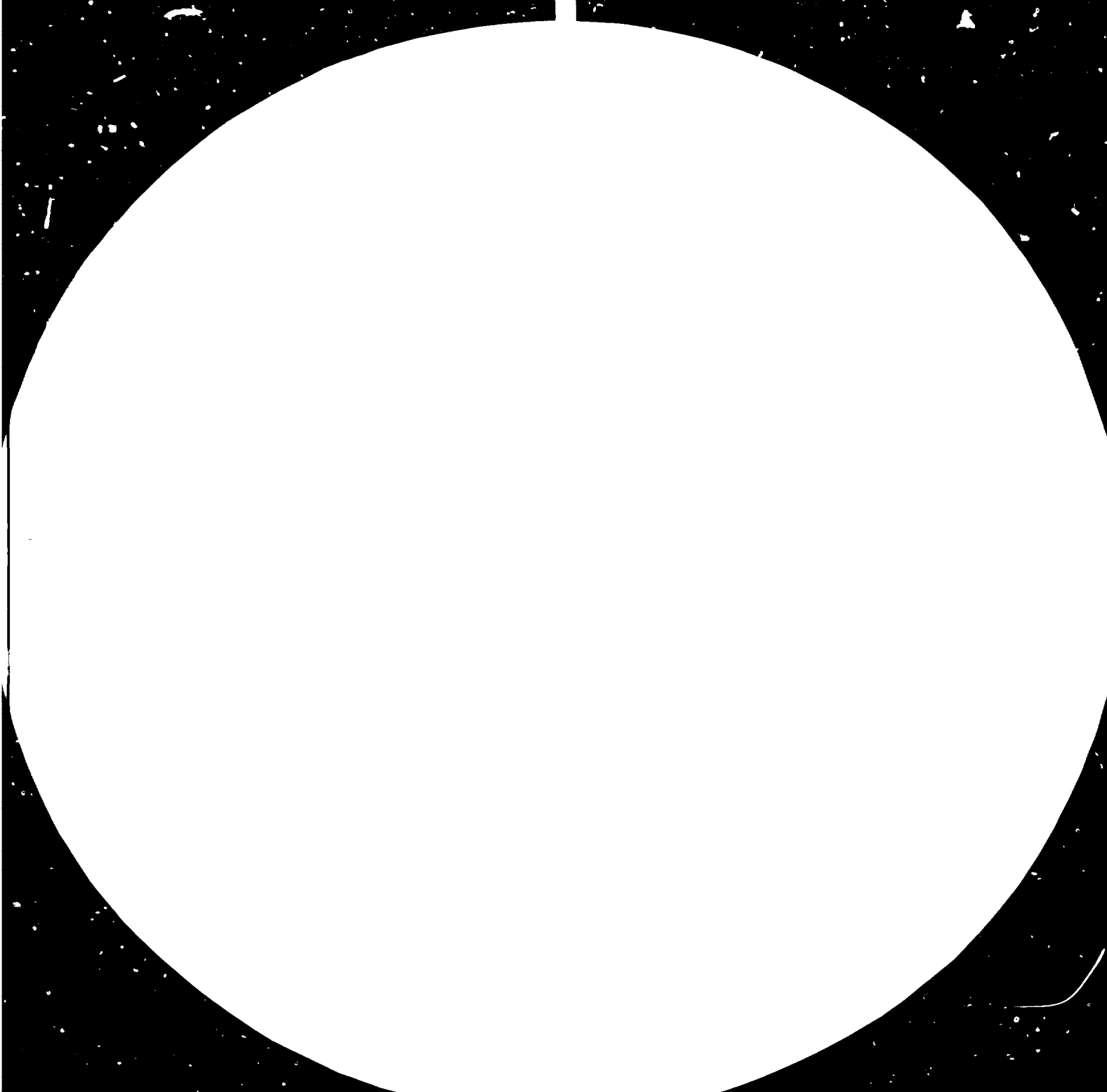

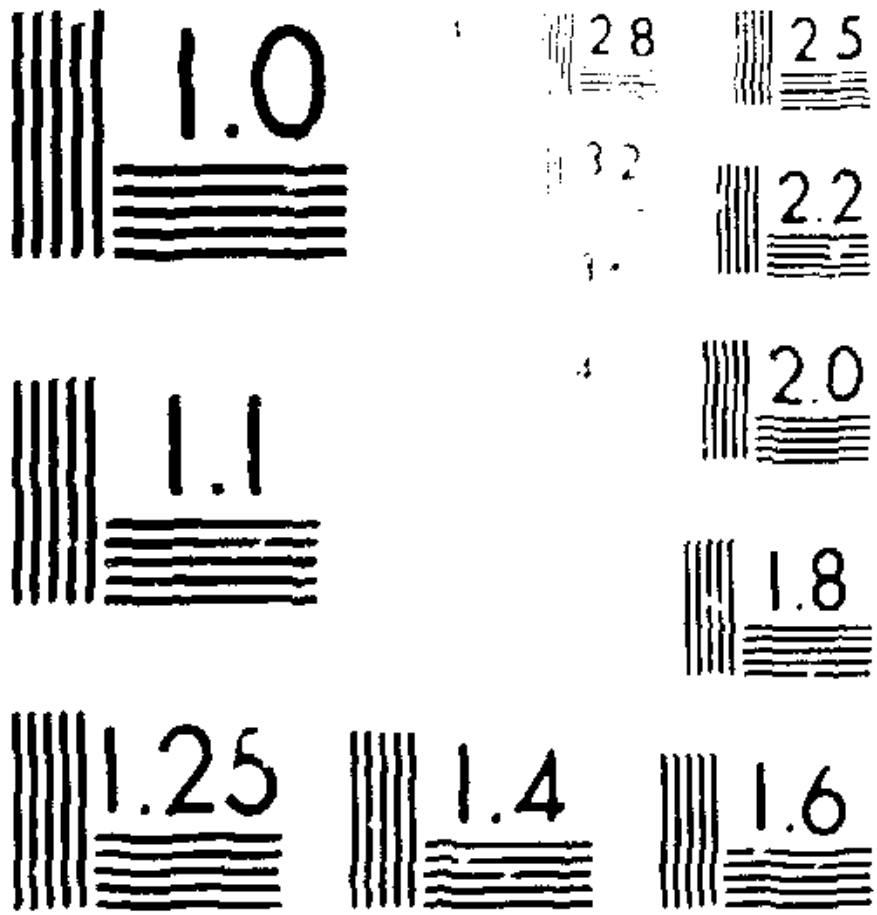
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CENTRAL METALLURGICAL RESEARCH AND DEVELOPMENT INSTITUTES OF EGYPT AND NIGERIA - A CASE STUDY *

by

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SUMMARY

The paper describes the experiences in executing UNIDO assisted Projects for the establishment of Metallurgical Research & Development Institutes in Egypt & Nigeria. The methods adopted in Egypt for establishing a bridge between the research & industry and the recommendations to ensure that CMRDI functions effectively to assist the industry have been described. The various stages from the genesis of investigation to the transfer of technology to the industry have been detailed.

The activities in Nigeria as described, include the preparation of a master plan of CMRDI, study of the local raw materials and the challenges that the Nigerian iron & steel industry faces.

In conclusion, the paper outlines the pre-requisites for mutual co-operation and twinning arrangements between the developing countries and also between the developed and developing countries.

Introduction

The Metallurgical Industries Section of UNIDO, has since its inception been assisting the developing Countries or expansion, modernisation and introduction of quality controls in the existing plants. The development of Metallurgical Research Centres has also occupied equally important place as the industries can not show any appreciable progress unless supported and backed by compatable research facilities. UNIDO'S metallurgical Industries Section has accordingly also assisted either in the establishment of new metallurgical centres, such as in Egypt, Nigeria, Pakistan etc or strengthened the existing facilities, such as in India, Yugoslavia etc. The assistance programme has been aimed to ensure that the research centres serve the metal producing and consuming industries in the country. More than seven countries have already benefitted by this programme and it is understood that some more assistance programmes are in the formulation stage. The Organisation of this workshop is also in its plans to strengthen Metallurgical research and this Workshop is involved directly with:-

- The requirements of metallurgical research and development manpower in the next 10 years.
- Evolve ways and means to ensure greater co-operation amongst the metallurgical research institutes, particularly in this and Pacific Region.
- Elaborate principles and guidelines of co-operative arrangements and twinning arrangements.

I am sure that this scope will in due course be widened to be inter-regional.

I have been asked to place before you my experiences as a UNIDO Project Manager of the Metallurgical Research Institutes in Egypt and Nigeria. I am quite conscious that this does not directly fall within the scope of your workshop but I am sure that sharing of one's experience is mutually beneficial.

My experiences with UNIDO sponsored Metallurgical research Institutes relate to:

1. Establishing and advising for effective functioning of a metallurgical research institute in a country that already has different metallurgical industries, some research facility and nucleus of research staff.

2. Plan and establish metallurgical research facilities, to meet the requirements of the metallurgical industries being set up with foreign collaboration.

The former conditions applied to Egypt and the later to Nigeria and the experiences of working in the two countries are described separately.

CENTRAL METALLURGICAL RESEARCH AND DEVELOPMENT INSTITUTE CAIRO (EGYPT)

To foster relationship between the metallurgical industry and research, UNDP approved a preparatory assistance of U.S. $100,000, followed by the 1st phase, in (1972-74), with UN inputs of U.S $463,700. this included the supply of equipment to the value of U.S $100,000, together with 108 man months of UN experts and training fellowships.

The success of the efforts during the first phase created the interest of the metallurgical industries that agreed to participate on equity basis, with the Academy of Scientific Research and Technology, the costs of buildings, services and the utilities for the CMRDI. The Egyptian Iron and Steel Co. agreed to hand over 7000 sq metre of land for the institute, in close proximity to the steel plant.

With the support and interest of the Egyptian metallurgical industries, the second phase was approved for 5 years, with the UNDP inputs of U.S. $1.86 million that was subsequently increased to U.S. $2.523 million and the project extended till 1932. The second phase included the supply of equipment for U.S. $1.335 million, 192 man months of experts services and training fellowship for 108 man months.

The CMRDI Cairo should now be operational at its new premises.

Besides assistance by the UNIDO experts to the counterpart staff for their research projects, the other major activities were:-

- Technical Assistance to the industry.
- Establishment & functioning of CMRDI.

TECHNICAL ASSISTANCE TO THE INDUSTRY

Owing to the limited laboratory facilities during the initial stage, it was planned that only such industrial problems would be undertaken which can be studied on the shop floor or with existing laboratory facilities. Accordingly, a few weeks after arrival in the field and familiarisation with the industrial and research set up in the country, a visit to all the metallurgical established was undertaken, with a view to identify the problems of the respective establishments that needed immediate investigations. After preliminary discussions at the plant, final round of discussions were held with the then Central Organisation, responsible for the entire metallurgical industries in Egypt. Detailed plans were drawn up, to be undertaken as and when the experts arrive in the field.

The following Criteria was adopted for selecting the topics that needed investigations.

- Study of the raw materials used by the respective plants, with a view to examine if such materials adversely affected the process.
- Evaluation of some of the existing plant practices with a view to improve quality and productivity.
- Import substitution and utilisation of indigenous materials.
- Introduction of quality control.

Excepting the studies on the raw materials, which needed the laboratory facilities, most of the other investigations were carried out on the shop floor by a joint team of UNIDO experts, staff members of the CMRDI as well as industry. The involvement of the UNIDO experts working with their own hands, resulted in such a confidence of the management

that they did not hesitate to place their plant facilities at the disposal of this team and instructions of the expert were followed by all concerned. A rapport was also established between the national staff of the research institute and the plant personnel.

As the counterpart staff members gained experience and won the confidence of the plant personnel, the UNIDO experts stayed in the background, assuming a secondary role but ensuring that the work proceeded in the right direction.

The success in the efforts to improve the quality and productivity as well as the production of some of the items hitherto imported, won the highest recognition for CMRDI. As the facilities were established at the new premises, the number of sponsored projects increased manifolds. In 1980. the total value of the projects sponsored to CMRDI exceed that of all other laboratories of the parent National Research Centre. The Projects sponsored included the different specialised fields viz, Mineral Beneficiation, Iron & Steel Making, Agglomeration, Foundry, Heat - treatment, Alloy steel development and Corrosion.

Technical Assistance was also rendered to the Egyptian Metallurgical Industries, through the UNIDO sub-contracts. The first sub-contract related to the pilot plant tests needed to be carried out urgently on the removal of sodium chloride from iron ores. Tests had to be carried out on a sub-contract and a solution had to be found to this problem urgently as the production was seriously hampered.

Another sub-contract activity involved a detailed study by a group of experts from a Japanese steel plant, that examined the existing steel making practise at the 3 non-integrated steel plants with a view to suggest and introduce improvements and changes. The team had not only suggested possible improvements but arranged demostrations and conducted trials to effect the improvement.

The CMRDI staff members have also been playing a key role as technical consultants to the Government for its development projects and it is hoped that in due course, the processes being developed at the Institute will be transferred to the industry for commercial exploitation.

ESTABLISHMENT & FUNCTIONING OF CMRDI

Besides assistance to the industry that resulted in the establishment of a bridge between research and industry, the second phase involved bringing into reality an effective metallurgical research Institute and this involved:-

- Master plan for CMRDI
- Re-organisation of research activities.

Master Plan for CMRDI

The Master plan for the institute elaborated & defined:-

- Aims, objectives and functions of the Institute.
- Institutional frame work- Board of Directors, and Consultative committee.
- Organisation set up and list of equipment.
- Detailed lay-out of the laboratories & pilot plants.

Whilst framing aims, objectives and functions of the CMRDI, the foremost consideration was that the Institute should be geared to the needs of the industry and in course of time, attain financial self sufficiency. Fundamental research was by no means to be ignored but used for training up of personnel and understanding phenomenan and mechanism that had some relationship with the applied work.

The CMRDI was recommended to be governed by a Board that was empowered to:

- Review the progress of work.
- Consider and approve the scientific and technical programme.
- Frame the annual budget and regulate expenditure.
- Determine the strength of staff and approve promotions and appointments.

The Consultative Committee, a higher body was expected to:

- Examine the recommendation of Board for its final approval/sanction.

- Frame by laws.
- Delegate authorities.
- Entrust any specific work to Board or constitute ad hoc committee.

Organisation set up and detailed list of equipment

Prior to the re-organisation, the entire staff belonged to the Metallurgy Section of the Inorganic Chemistry Division and it was of paramount importance that the activities be channelised through the different and well identified disciplines. Accordingly, the activities of each Section/Division were clearly defined and the existing staff allocated to the respective Sections/Divisions, according to their experience and interest. A detailed recruitment programme was then drawn up to fill in the vacant gaps.

Decentralisation and accountability at all levels was the essence of the recommendation, so also was the need to strengthen the technical services.

A detailed list of Laboratory and Unit pilot plant equipment was drawn up and inspite of the price escalation every effort was made so that minimum basic equipment was provided from the U.N.D.P. Funds.

A number of reports were also prepared which included the personnel policy for recruitment, promotions, incentives; contract research and financial control; research co-ordination and follow up; short and long range research programme that fitted in with the overall industrial development plans.

The re-organisation of research activities:-

The success of a research institute depends not only on the equipment, buildings, personnel but on the selection and execution of the research projects, aiming at the transfer of technology and this necessitated re-organisation of research activities.

It was emphasised that the in house R&D activity should be geared

to play an effective role in the economic growth and the industrial development, resulting in the transfer to technology from the forewalls of the research institute to the industrial establishments. For the realisation of such aims and objectives, the following guidlines were recommended:-

- The topic for investigation should fit in with the overall industrial development plans.
- ,Methodology should be easily adaptable on the industrial scale.
- The proposal for the industrial implementation should be supported with:-
  - (i) adequate pilot plant tests;
  - (ii) consumer acceptance of the product;
  - (iii) techno-economic and feasibility study.
- The services of Consulting Engineers should be used at all stages till the completion of test trials.

The following describes each of the above mentioned criteria.

Topic for investigation

The topic for investigation is of paramount importance and the concerned Scientist/Engineer should bear in mind that the investigation will not be over after the completion of the Laboratory/pilot plant studies but only after the results have been transferred to the industrial practice. A case study of the projects that fail to achieve the desired results was recommended, so as to avoid future failures and pit falls.

The topic for investigations should be based on either of the following criteria;

- utilisation of indigineous raw materials.
- Utilisation of surplus power or energy.
- Demand of the products.

With a view to utilise the indigneous raw materials, studies on the characteristics and treatment, if needed, for processing into semi-finished or finished products should form an important part of the programme.

Most of the countries, excepting the oil rich countries have power shortages and only oil rich countries can plan to utilise the surplus energy for the electro-metallurgical industry or using surplus gas for heating and chemical reactions such as sponge iron production.

In certain cases, though the raw materials including ores, metals and certain chemicals etc., may not be produced locally but it may be desirable to import the same to produce materials which are in demand in the country. This may not necessarily produce items at prices lower than the imported ones, but this far outweighs the advantages that are:-

- Less expenditure in foreign exchange.
- Increased employment.
- Industrial growth.

Research plan and Methodology

After the research theme and its objectives has been defined, a detailed literature survey is undertaken, and details of the plan of work, outlined, keeping in view the ultimate commercial exploitation under the local conditions viz. the demand; environmental conditions cost of ancillaries and other raw materials, etc. The greater chances of success would be for a plan of work where the proposed methodology or the materials have established commercial feasibility. This by no means implies that studies on the hitherto unexplored paths have to be neglected; depending on the merit of each proposals these should in fact be encouraged. It is, however, desired that a realistic balance be struck in the two approaches and the concerned scientist should be able to justify his plan of work on sound scientific, technological and economic principles. If the idea is both scientifically and economically promising, the plan must be pushed through.

A major break-though in the metallurgical field during the last decade has been due to the new approaches, aiming at faster chemical and physical changes; better control for elimination of impurities; development of new alloys and materials to withstand extreme service conditions. Such developments include use of oxygen in ferrous and non-ferrous extraction, use of inert gas and vacuum for production and refining of metals and alloys; continuous steel-making (still under development); composite materials, super alloys and ultra-high strength steels. All such developments have been possible on account of very clear understanding of basic principles and their applications leading to ultimate success.

After the successful development of the laboratory scale studies and the preliminary pre-feasibility study, the next step is the pilot plant test.

Pilot Plant Tests

The laboratory scale studies are carried out under ideal and controlled conditions which may hardly be possible under the actual conditions, that would exist during the production and no entrepreneur or industrial establishment would consider adopting a technology and process unless it is supported by pilot plant data obtained from continuous operation, simulating as far as is possible and permissible, the actual condition on the pilot plant.

The capacity and size of the pilot plant should be such that would enable the Consultants and Design Organisations to draw the procurement specifications or design a particular unit/plant for commercial scale operations.

Consumer Acceptability

Though the laboratory and pilot results furnish adequate information needed for industrial implementation, however, such proposals very much strengthen the hands of the R and D personnel, if supported by the field test results and prefeasibility study.

The field tests indicating consumers acceptance are required to be conducted by the parties likely to use the materials or market the same in some form or the other and are in addition to the standard

tests that should normally be carried out and included in the report, furnishing requisite information for consideration of the entrepreneur.

The parties to conduct such tests should be chosen from amongst those that are already using similar materials either from imports or local produce. Such tests should preferably be carried out by joint team consisting of staff of research establishment and the consumer as there is always some reluctance in testing new products.

Techno-Economic and Pre-Feasibility study

In addition to the consumer acceptability, the proposal for the establishment or the adoption of a new process should include a techno-economic or feasibility study, that should include:-

- Brief outline of the process and its advantages.
- Applications and demand in the country, as well as possibilities of exports.
- Raw materials:
  - (a) Specifications.
  - (b) Availability-including existing production/reserves and the sources of supply.
  - (c) Approximate cost.
- Utilities power, fuel, and water requirements.
- Material balance.
- Waste products and recommendations for disposal.
- List of equipment.
- Approximate cost of production.
- Consumer acceptability and test reports.

Such a study should best be undertaken by a Design Engineering group of the Institute and the report should be jointly prepared by the concerned scientists. The pre-feasibility study should form the basis for a decision on the commercialisation of the process.

After the entrepreneur decides to exploit the process, it is desired that Consulting Engineers be entrusted with all work leading

to test trials.

Incentives and risk coverage

Though the entrepreneur is justified in seeking process guarantees or some form of risk insurance, it is equally important that the scientists and technologists involved with the development also share in the financial benefits. The details of guarantees and risk can be worked according to the local regulations. Such arrangements will result in involvement and participation of all concerned with the development, thus ensuring the smooth transfer of technology from the research laboratory the industrial floor.

The adoption of any pilot plant scale operation into commercial practice and the willingness of the industry in the developed countries has been due to the availability of requisite design and fabrication facilities and the experienced operative staff. Developing countries, if not backed by such engineering infrastructure, may not be able to commercialise such developments and under such circumstances it may be desirable to avail of the services and facilities of other overseas organisations in developing or developed countries, where such facilities may be negotiable.

It would be sometime before the results of the new R & D activity of CMRDI of Egypt bear fruit. Suffice it to say that a number of scientists and delegations that had visited Cairo to assist the Egyptian Government in the implementation of its Scientific Policy, had commented that the CMRDI is an example to follow.

I would be failing, if I did not mention the problems that we faced in Egypt and these were:

- Reluctance by the staff members to shift to the new place, that was 35km from the existing place of work. This problem was overcome by offering incentives to the existing staff.
- Brain drain to the more affluent countries in the region.
- Poor salary structure of the scientists, as compared to the private sector and industry.

These are the problems common to most of the developing countries.

CENTRAL METALLURGICAL RESEARCH & DEVELOPMENT INSTITUTE JOS (NIGERIA)

With a view to assist the Nigerian metallurgical industries and to reduce and gradually eleminate reliance on foreign institutes for the transfer to metallurgical technology and its adaptation to Nigerian conditions, thus promoting the growth and expansion of forrous and non-ferrous industries in Nigeria, the Federal Government of Nigeria decided to expand the existing facility of Metallurgical Research & Test Division of the National Steel Division of the National Steel Council into a full fledge Metallurgical research institute. The I.F.S.T.D., with UNIDO as the executing agency agreed to assist the Federal Government of the Republic of Nigeria and contributed U.S. $632,000 and the Government contributing U.S. $720,480 for a programme spread to 4 years.

The assistance includes the services of Project Manager (36 months) and experts in different fields for a total period of 66 months, U.S. $500,000 toward equipment and 88 man month for training of the National staff.

The main aim being, to establish and bring to a satisfactory level of operation the Metallurgical Research and Development Institute to serve the Metallurgical industries.

With the joining of the Project Manager in the last week of March 1981, the Project is operation and during this, the main activities have been:

- Planning of CMRDI.
- Formulation of work programme, to assist the Nigerian metallurgical industries.

The following describes the respective activities in detail:

Planning of the CMRDI

After formulation of the organisation set up, the details of the different laboratories and pilot plant sheds and various offices etc. have been worked out to enable the architects to prepare detailed designs of the institute.

Government has acquired a big piece of land that will not only suffice for the laboratories, pilot plants and offices but some of the houses of the staff members would also be built. In developing the layout, adequate care has been taken for future expansion of the activities and the growth of the institute.

Owing to the heavy demand by the steel plants and rolling mills being set up, the country faces acute shortage of Metallurgist and other Engineers to man the Metallurgical research institute. In order to initiate timely action for recruitment and training, a long range recruitment plan and manpower requirement till 1989 has been prepared and action initiated for phased recruitment.

Nigerian Metallurgical Industry and CMRDI

A big expansion of Nigerian Metallurgical Industry is being planned, the Ajaokuta Steel plant with an initial capacity of 1.3 million tons will be expanded in phases to 5.2 million tons the plant is based on conventional blast furnace/oxygen steel making route and will use the nearby iron ore deposits at Itakpe and coke produced from local and imported coals.

A direct reduction steel plant based on Midrex process, with an initial capacity of 1 million tpy is likely to go into production within a few months. The billets from the DR plant will feed the three rolling mills being set up in different parts of the country.

Besides, small foundries and some fabricating units, the Niger steel plant is producing 6,000 tons per year of reinforcing rods from the local scrap and is operating much below the rated capacity.

The immediate programme of the CMRDI thus relates to the study of the indigenous raw materials and critical review of the technology most suited to the local conditions.

The CMRDI scientist along with plant personnel attend to any overseas tests or discussion on local raw materials for the iron & steel industry. They would also be attached to the plant as and when the plant will be commissioned tests runs started.

It is also recommended that CMRDI scientists be jointly involved with the quality control personnel, when the plants go into production. This will not only enable the scientists to acquire practical experience, strengthen contracts with the plant personnel but valuable data would be collected, which could form the basis of the R & D activity of the CMRDI, working for the benefit of the industry.

CO-OPERATIVE AND TWINNING ARRANGEMENTS

In view of the limited man power and limited facilities, the institutes in developing countries should co-operate to make use of the experience of others. Such co-operation and twinning arrangements can be between the:-

- Institutes in a developed & developing country.
- Institutes in developing countries.

The co-operative and twinning arrangements between the institutes in a developed and developing country would lead to fruitful results, such an arrangement works under the overall umbrella of technical assistance programme of the government. Another alternative can be purely commercial, and an institute in a developed country may partly off load some of its activity to an institute in a developing country. The later has its own advantages and enables the institutes in a developing country to:-

- Earn foreign exchange, much needed to enable the procurement of equipment & spares.
- Establish closer professional contacts, exchange of information and visits, to the mutual advantage of both the organisations.
- Orient the activities, more towards undertaking sponsored projects, fullfilling the conditions of contract i.e. proper planning and execution of the projects in strict time schedule demanded by the sponsorers. This in turn would result in overall improvements and execution of in-house projects.

The institutes in the developing countries will, however, have to win the confidence not only for their technical competency but also that

the results of findings will not be divulged to others.

The twinning arrangements between the institutes in the developed and developing countries can be for:

- availing of the special facilities or services of experts for conducting specialised laboratory & pilot plant tests in the developed country.

- Execution of a development project in a developing country, jointly planned and supervised by the scientists in the two countries. Most of the work being carried out in the developing country and only the work for which facilities do not exist to be carried out in the developed country. This involves visit of scientists and senior personnel of the two countries.

Such joint programmes or tests involve expenditure in a developed country and no institute may be interested in such assistance unless it is backed and financially supported by the respective Governments or international aid agencies.

Co-operation amongst the developing countries:

This workshop is directly involved with the ways and means to establish and strengthen co-operation amongst the developing countries - the following suggestions may be considered.

The institutes, co-operating may prepare a detailed list of services and pilot plant equipment available for use by others.

- The institutes desiring assistance, to prepare details of tests or facilities needed.

- Training of the personnel at all levels at both places.

- Exchange of unclassified reports & publications.

- Joint symposia/workshop and training programme.

- Exchange visits of specialists of the two countries.

It is hoped that the deliberation of this conference will result in adoption of concrete steps ensuring greater co-operation of the different metallurgical research institute.