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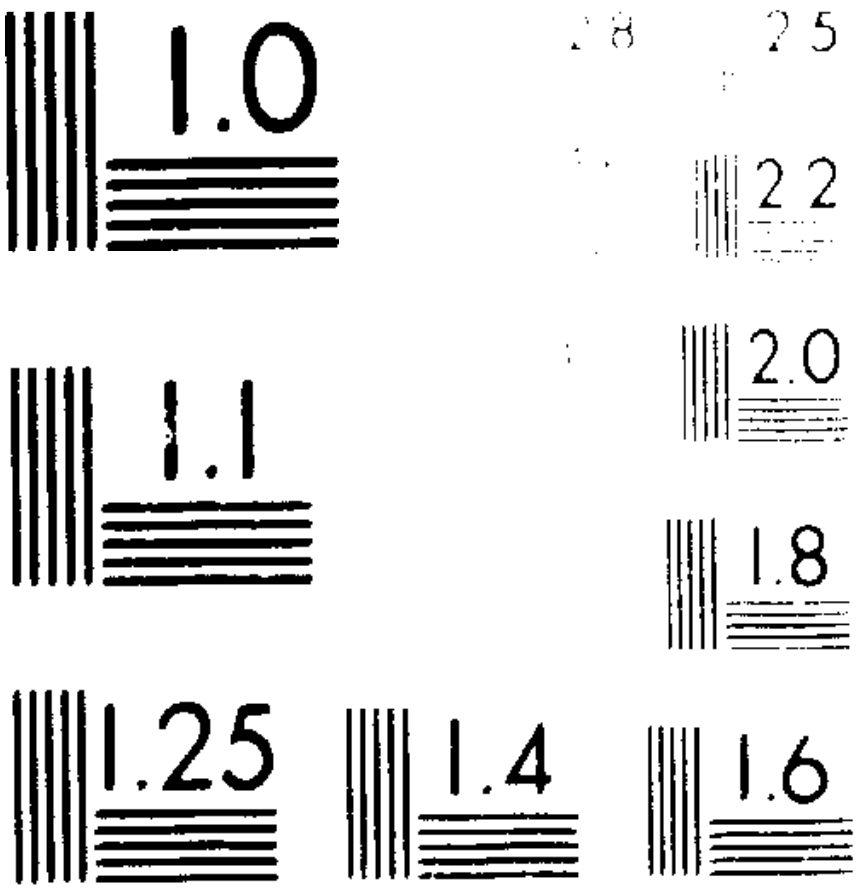
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TECHNOLOGICAL CO-OPERATION AMONG DEVELOPING COUNTRIES -- A SUGGESTED WORK PROGRAMME TO BE TAKEN UP BY THE TECHNOLOGY PROGRAMME

Draft study*

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PREFACE

Following the New Delhi meeting of Heads of Science and Technology Agencies of Developing Countries held in May 1982, Technology Programme has tried to elaborate the measures by which the recommendations of that meeting could be carried forward for assisting the implementation of the Caracas Programme of Action.

The following draft study analyses the issues and problems involved in building up/strengthening technological capabilities of developing countries and suggests some specific activities that may be taken up by the Technology Programme for intensifying co-operative efforts among developing countries for achieving greater self-reliance in their technological and industrial development.

Chapter I of the draft study discusses the growing need as well as the scope for enhancing technological co-operation among the developing countries with a view to reducing the existing distortions and imbalances in the international technology order. Chapter II reviews the recommendations and decisions of major international meetings on ECDC and TCDC as well as the sectoral consultation meetings for promoting greater technological co-operation among the developing countries. Chapter III analyzes the important activities already initiated by UNIDO for enhancing the technological capabilities of the developing countries and strengthening co-operative links among them. Chapter IV outlines some specific mechanisms, methodologies and activities for further strengthening technological co-operation among developing countries for achieving greater technological self-reliance needed for achieving accelerated growth in areas of priority concern to developing countries.

The draft study also contains suggested standard formats (Annex IV to VII) for collection of information relating to technological capabilities of developing countries, including research and development institutions, consultancy and engineering organizations, individual experts etc. in specialized fields which are of priority concern to developing countries.

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TECHNOLOGICAL CO-OPERATION AMONG DEVELOPING COUNTRIES

CHAPTER I

Introduction

1. The present international situation is characterised by gross imbalance in the industrial and technological development between the industrialized and the developing countries. The continuing heavy technological dependence of the South on the North has had an impact on the social and economic development of the South that has not always been positive or beneficial for the South. The pattern of industrialization that has emerged as a consequence of the one-sided dependence of the South on the North has often not been appropriate to the conditions and constraints obtaining in the developing countries, nor commensurate with their special needs, priorities, aspirations and objectives.

2. It is now being increasingly recognized that, in order to alter this situation and quicken the pace and improve the quality of industrial and technological development of the South, there is need for the developing countries to pursue a deliberate strategy of greater technological co-operation among themselves. This strategy is to be pursued by the developing countries not in isolation but simultaneously with continuing efforts to improve their links with the industrialized countries for acquiring on more reasonable terms the sophisticated technologies which are not easily available in the South.

3. Collective self-reliance is now seen as an effective means of improving the co-operative utilization of existing as well as potential complementary resources, both human and material, of the developing countries for their individual and collective growth. The critical importance of technological co-operation stems from the fact that it constitutes an essential factor in the development of a sound programme of action in various other fields of economic co-operation among developing countries.

4. Collective self-reliance among developing countries is not unidimentional either in concept or in content. It is an all inclusive process which calls for policies and measures aimed at strengthening the domestic technological capabilities of developing countries on the one hand and improving their negotiating capacity and bargaining power vis-a-vis the developed countries on the other.

5. To a large extent the distortions and imbalances which afflict the present international technological order stem from the structure of the international technology market itself. This market is controlled and dominated by a few Transnational Corporations who develop and commercialise sophisticated technologies. Through their enormous power and extensive network, they are able to determine not only the type of technologies that are developed but also the terms and conditions on which they are transferred, irrespective of whether they are in the intrinsic interests of the developing countries or even detrimental to them. The situation is compounded by the fact that most developing countries do not have adequate regulatory mechanisms or machinery to ensure that technology inflow is really in tune with their larger development goals and objectives. To reverse the trend of technological overdependence on the North the developing countries have been seeking to establish appropriate mechanisms, methodologies and programmes for enlarging co-operative activities among themselves for mutual benefit.

6. The need as also the scope for enlarged co-operation among the developing countries has increased due to a number of developments. Some of the more important ones are —

(i) The developing countries possess different levels of technological capabilities and infrastructural facilities. Some larger developing countries and a number of smaller newly industrializing ones have attained considerable technological sophistication both in terms of absorption and adaptation of foreign technology and also in the development of indigenous processes and techniques;

(ii) some developing countries have emerged as capital surplus countries while some have become major producers and exporters of diverse items of capital goods and equipment;

(iii) technological service capability, including comprehensive consulting and engineering services in different industrial sectors and ability to undertake and execute complete turnkey jobs, has also grown in some developing countries and they are in a position to successfully transfer benefits to others;

(iv) some developing countries have created competent research and development infrastructure in several key areas which are of direct concern and interest to many other developing countries;

(v) the development banking system in some developing countries has reached a level of maturity and sophistication and is able to contribute to technological development and facilitate technology transfer;

(vi) the problems and challenges of technological development facing the developing countries tend to be of a similar nature. Their technological experience and needs also bear close affinity;

(vii) at the political as well as operational levels there is greater awareness as well as desire for intensifying co-operative efforts among developing countries.

The heightened possibilities for greater technological co-operation among developing countries is already reflected in the significant upward trend noticed during the past decade or so in the quantum of technology flows among developing countries as well as in the share of trade in technology intensive manufactures, turnkey sales and

joint ventures. The over-all situation is thus quite conducive to realising significant gains through co-operative activities among developing countries provided appropriate mechanisms and programmes can be evolved for the purpose.

CHAPTER II

REVIEW OF RECOMMENDATIONS OF IMPORTANT INTERNATIONAL MEETINGS

7. Not only the scope, but the desire for greater technological co-operation among developing countries has also grown steadily over the years. It is manifested in a series of declarations, resolutions and decisions of several international forums and meetings, both within the UN system and outside. These meetings have underlined the necessity for developing countries themselves to become active instruments of their industrial and technological transformation through effective co-operative efforts and application of their own resources, knowledge and skills. They have also succeeded in evolving broad guidelines and identifying major areas in which technological co-operation among developing countries can be concretely promoted for the individual as well as collective benefit of developing countries, including the least developed ones.

8. The Lima Declaration and Plan of Action adopted at the Second General Conference of UNIDO in 1975, while envisaging that at least a quarter of world industrial production should originate from developing countries by the year 2000, emphasized the importance of closer industrial and technological co-operation among the developing countries as an important means of achieving that objective.

9. The Round-Table Ministerial Meeting held in New Delhi in January 1977 underlined the need to identify concrete areas of co-operation and of the importance of pooling the experiences and resources of the developing countries with the aim of evolving a common strategy for their industrial and technological development. It indicated certain methodologies through which and specific areas in which co-operative efforts were required to be pursued. These included identification and use of technologies already available in the developing countries, collaboration in respect of establishing

a clearing house for technological information, strengthening consultancy and engineering capabilities, establishing and strengthening of national and regional institutions concerned with industrial and technological development, co-operation in applied research and development in specific sectors, manpower development and training, etc.

10. The United Nations Conference on Technical Co-operation Among Developing Countries (TCDC) held at Buenos Aires in September 1978 stressed the need to foster the self-reliance of developing countries through enhancement of their creative capacity to find solutions to their development problems in keeping with their own aspirations, values and special needs. The Buenos Aires Conference highlighted the need for exchange of experience, the pooling, sharing and utilization of resources and for development of complementary capacities as means to building up collective self-reliance among the developing countries. It underlined the value of technology as a critical factor in achieving rapid economic development and emphasized the need to strengthen existing technological capacities in the developing countries, including the traditional sector, to improve the effectiveness with which such capacities are used and to build up new capacities and capabilities as well as to promote the transfer of technology and skills appropriate to their resource endowments and development potentials. The TCDC Conference further recommended that the developing countries should, wherever possible, exchange among themselves their experiences in the formulation and implementation of their plans and policies for the orientation of science and the transfer and development of technology to their own development objectives, needs and capabilities.

11. Among the concrete steps for building up greater technological self-reliance of the developing countries, the Plan of Action adopted at Buenos Aires suggested the formulation of technology plans by developing countries as an integral part of the overall

national development plans, setting up of scientific and technological data banks, encouraging indigenous research and development, undertaking joint research activities and sharing their results, strengthening national research and design institutions, promoting linkages and networks among research and development institutions of different developing countries, undertaking special measures to strengthen the potentials in consultancy and engineering services, etc.

12. The United Nations Conference on Science and Technology for Development (UNCSTD), held in Vienna in August 1979 was a major milestone in international efforts to promote concerted and systematic use of Science and Technology for the all-round development of developing countries. It adopted the Vienna Programme of Action whose main focus was the strengthening of scientific and technological capacities of developing countries through endogenous scientific and technological capacity building. The effort of UNCSTD was directed chiefly to finding suitable ways and means for enabling developing countries to use science and technology for solving their own developmental problems and also for providing instruments of co-operation to developing countries in the utilization of science and technology for tackling socio-economic problems that cannot be solved by individual action alone.

13. Strengthening technological co-operation among developing countries forms one of the major components of the operational plan drawn up for the implementation of the Vienna Plan of Action. The other components include scientific and technological policies and plans, scientific and technological information, the creation and strengthening of scientific and technological infrastructure, choice, acquisition and transfer of technology, strengthening of research and development infrastructure and its linkage with the production system, etc. The need for creation and strengthening of national capacity for providing consultancy and engineering services was also specifically mentioned as an important catalytic agent for strengthening technological and industrial capability and promoting technological co-operation among countries.

14. The High-Level Conference on Economic Co-operation Among Developing Countries (ECDC) held at Caracas in May 1981 further elaborated and articulated the basic recommendations of the United Nations Conference on Science and Technology for development and made specific action-oriented suggestions for strengthening technological co-operation among developing countries with a view to maximizing the contribution of science and technology to their economic and social development. The key areas identified by the Caracas meeting for making intensive co-operative efforts among developing countries relate to information, technology flow, advanced technologies, negotiating capacities and institutional infrastructure. Some of the major recommendations in respect of those areas are:

15. Information

i. Compilation of information on available technologies in developing countries;
ii. promotion of co-operative arrangements among technological research and development institutions in specific areas;
iii. strengthening of technological information among developing countries using existing international information systems;
iv. monitoring experiences regarding absorption, adaptation and innovation of technologies;
v. strengthening the Technological Information Exchange System (TIES).

16. Technology Flow

i. Systematic compilation of information on broad range of technologies of each developing country to be made available to other developing countries and international organizations;
ii. reciprocal preferental treatment arrangements to be established without prejudice to national legislation;
iii. promoting, organizing and providing support for inter-country facilities and exchange of information;
iv. establishment of networks of scientific and technological institutions for mutual benefit.

17. Advanced Technologies

i. Monitoring, assessment, analysis and review of the potentialities and implications of advanced technologies,
ii. promoting research and development facilities and institutional mechanisms for enabling developing countries to acquire necessary skills.

18. Enhancing Negotiating Capacity

i. Promoting utilization of services of developing country consultancy organizations in regard to implementation of projects involving technology supplies from developed countries:
ii. strengthening the Technological Information Exchange System;
iii. collection and dissemination of information on terms and conditions and consequent elaboration of model contracts for transfer of technology from developed countries
iv. publication of bulletin containing information on technology transfer contracts and laws and available technologies.

19. Institutional

1. Establishing and/or strengthening national agencies dealing with science and technology;
ii. encouraging twinning arrangements between science and technology institutions;
iii. formulating co-operative arrangements among technological research and development institutions in specific areas;
iv. establishing networks of scientific and technological institutions for mutual benefit.

20. Pursuant to the relevant recommendations of the Caracas Conference, a meeting of Heads of Science and Technology Agencies of Developing Countries was held in New Delhi in May 1982 with a view to ensuring and enhancing implementation of the relevant measures proposed in

the Caracas Programme of Action. The New Delhi meeting also examined further action to be taken by the Group of 77 in regard to technology development and technological co-operation.

21. The New Delhi meeting identified national focal points (Annex I) to provide for a specific framework for concrete co-operative arrangements among developing countries backed by requisite financial allocations by member states specifically for ECDC activities. In order to ensure concrete follow-up action on the deliberations of the meeting, it also identified specific S+T areas (Annex II) and set up action committees (Annex III) to suggest concrete programmes of co-operation. The priority areas identified for launching co-operative programmes include energy development, health care and nutrition, agriculture, industrial technology, technology for rural development, modern technology, resource engineering, communication systems, chemicals and fertilizers, transportation, low cost housing, etc. These are essentially the areas which are of major concern to developing countries in their efforts to secure improved quality of life for their people.

22. Like the meetings that preceded it, the New Delhi meeting also emphasized the crucial necessity for systematic compilation and dissemination of information on technologies, capabilities and expertise available within the developing countries to serve as a starting point for increased technological co-operation among them. It stressed the importance of creating and maintaining up-to-date inventories of capabilities in science and technology developed by developing countries themselves. The inventories ought to cover not only the technologies already developed and commercialised but also information on research in progress or planned, expertise in the form of technically trained and skilled manpower available etc. In order to be able to elicit the needed information from developing countries in a systematic manner and to repackage it to suit specific user needs, it is necessary to

design a suitable questionnaire or standard format for circulating to the member states and obtaining their responses. Care has to be taken to ensure that information collected is not of too general a nature but that it relates to the specific priority areas already identified so that it helps problem solving. For the information to be of practical value it would have to be need-based user-oriented.

23. The New Delhi meeting also underlined the urgency of formulating co-operative arrangements through creation and strengthening of network of institutions in science and technology and also through intensification of exchange involving experts. Such co-operative arrangements are required to be made in the priority areas already identified.

24. For facilitating technology flow among developing countries various critical and potentially fruitful areas of co-operative endeavour were highlighted by the meeting. These include consultancy and engineering services, pilot and demonstration plants, proto-types etc. The need to avoid triangular transfer of technology whereby a developing country technology is commercialised in a developed country before it is transferred to another developing country was also stressed. The meeting also desired that the information available on technological capacities of developing countries should be compiled through a simplified proforma and continuously updated. In order to strengthen negotiating power of developing countries vis-a-vis developed country technology suppliers, it advocated the establishment of National Registers of Foreign collaborations to help in drawing appropriate lessons from the experiences of other developing countries in respect of the acquisition of foreign technology.

25. While underlining the role of experts as important carriers of technological information the meeting called for the preparation of rosters of experts in developing countries in priority areas in

order to facilitate their identification, selection and placement.

26. As a means of making available certain urgently needed technologies to developing countries, it was considered necessary to prepare technology profiles in selected sectors such as power projects, civil construction etc.

27. The meeting also stressed the crucial role played by consultancy organizations in facilitating technology flow, particularly at the stage of pre-manufacturing activities and in disaggregation of technology packages. It advocated a consortium approach to technology acquisition, wherever feasible.

28. The need for intensified co-operative efforts in areas of innovation and research in advanced technologies was prominently highlighted in the meeting. It was considered necessary to sensitize planners, policy makers and the scientific and technological community to the potentials and implications of advanced technologies such as biotechnology, genetic engineering, micro-processors etc. Action Committees were required to be constituted in specific areas of advanced technologies to examine their relevance and identify needs for education, research and training etc. for promoting their development for the benefit of the developing countries.

29. As regards enhancing negotiating power of the developing countries vis-a-vis technology suppliers in industrialized countries, it was considered necessary to compile information on technologies acquired by developing countries over a period of time. It was felt that relevant information on terms and condition of technology acquisition would be an invaluable aid in negotiations with industrialized country technology suppliers.

30. With a view to systematically regulating technology inflow it was of considered that an analysis of national legislation in

selected countries having influence on technology transfer should be made and results disseminated for the benefit of all developing countries.

31. Apart from the meetings whose important recommendations have been reviewed above, the problem of enlarging technological co-operation among developing countries for enhancing their collective self-reliance was also emphasized in the Lima Declaration and Plan of Action (1975) and the New Delhi Declaration and Plan of Action (1980). The round-table ministerial meetings convened by UNIDO in New Delhi in 1977 and in Istanbul in 1979 also discussed the issues involved in considerable detail and suggested several guidelines for co-operation.

32. The System of Consultations, involving permanent dialogues among representatives of industry, consumer groups, financial institutions, labour and Government, on selected industrial sectors provides yet another forum for examining, inter alia, the significant technological constraints which inhibit the growth and development of particular sectors, possible ways and means to overcome those constraints as well as for elaborating the implications of major technological trends and [illegible]ts in those sectors. The system is also designed to con[illegible], the widening and strengthening of industrial and technolog[illegible] co-operation among all countries, including among the developing countries.

33. Some of the significant technological problems to which pointed attention has been drawn by the consultation meetings and which could possibly be resolved through co-operative efforts among developing countries are the following:

34. Fertilizer Industry

34.1 Problem areas:

Design, manufacture of equipment, machinery and spare parts and construction of fertilizer plants.

34.2 Co-operation evisaged through:

i. The collection and dissemination of information on the availability in developing countries of capacities to design and manufacture machinery, equipment and spare parts, and to provide engineering services and construct fertilizer plants;
ii. identification of opportunities for specialization in different developing countries in the manufacture of standard equipment and machinery for fertilizer plants;
iii. identification of available technologies and plant engineering designs that could be used for building mini-fertilizer plants. This would be of particular interest to least developed and small developing countries where the domestic demand for fertilizer may not be sufficient to warrant setting up large scale production facilities. It is also relevant for land-locked developing countries or land-locked regions of a country with inadequate transportation network and high transportation costs.

35. Agricultural Machinery Sector

35.1 Problem areas:

i. Lack of inadequate research and development infrastructure;
ii. lack of information on and links with technological developments in other countries;
iii. lack of negotiating and contracting capabilities;
iv. mechanization often inappropriate to local conditions.

35.2 Co-operation envisaged through:

i. Exchange of information on technological developments in other countries;
ii. establishing linkages among research and development institutions in developing countries, as well as with international research and development institutions in developed countries;

iii. UNIDO assistance in the form of formulating technological guidelines and profiles on the manufacture of appropriate equipment such as centrifugal pumps, small tractors, forged hand tools;

iv. drawing up model contracts for purchase of technology from other countries.

36. Petrochemical Industry

36.1 Problem areas:

i. lack of technological information and know-how about emerging petrochemical techniques in the development of new end uses and in research and development on new end uses of petrochemical products such a plastics in the agricultural, housing, packaging, transport and construction sectors;

ii. lack of co-operation between developing countries having oil and gas resources and other developing countries not having such resources;

iii. lack of or insufficient appropriately trained personnel.

36.2 Co-operation envisaged through:

i. analysis and dissemination of the implications of the emerging technologies concerning new end uses of petrochemical products and in establishing or strengthening research and development through co-operative efforts;

ii. study of various technical training schemes in the petrochemical industry available to developing countries with a view to recommending the most effective form of training for ensuring the maximum transfer of technology in the shortest possible time.

37. Capital Goods Industry

37.1 Problem areas:

i. inadequate technological infrastructure;

ii. difficulty in keeping up with technological developments and adapting technologies and training programmes to specific requirements;

iii. shortage of information on sources of technology.

37.2 Co-operation envisaged through:

i. analysis of technological trends and perspectives in selected areas of capital goods industry and their implications for developing countries and making the information available to developing countries for assisting them in formulating industrial and technological policies and plans in the capital goods sector;

ii. making information available to developing countries on the technological alternatives, their availability, results, costs and commercial conditions for their acquisition;

iii. exchanging information among developing countries in capital goods technologies and engineering services;

iv. preparation of a comprehensive list of suppliers of technology of different levels of technological complexity.

38. Iron and Steel Industry

38.1 Problem areas:

i. lack of basic infrastructure;

ii. lcak of research and development facilities;

iii. shortage of coking coal.

38.2 Co-operation envisaged through:

i. study to assess alternative technologies for economizing coking coal and using suitable substitutes;

ii. exchange of technical information with special emphasis on co-operative arrangements between research and development institutions in developing countries;

iii. study of alternative technologies used for mini steel projects.

39. Pharmaceutical Industry

39.1 Problem areas:

i. shortage of technological and manpower resources;
ii. lack of domestic research and development capacities;
ii. difficulties in obtaining suitable technology from developed countries.

39.2 Co-operation envisaged through:

i. setting up of possible joint ventures or making other commercial arrangements with a view to improving developing countries' negotiating power;
ii. preparing model scheme for promoting local research and development institutions in order to absorb, assimilate and further develop the technology acquired, with particular attention to quality control operation;
iii. exchange of information and experience with other developing countries having well-established pharmaceutical industry, such as Yugoslavia, Romania and India;
iv. co-operation in processing medicinal plants.

40. Vegetable Oils and Fats Industry

40.1 Problem areas:

i. low productivity due, among other factors, to antiquated harvesting technology;
ii. antiquated oil seed processing methods and technologies;
iii. lack of appropriate technologies for manufacture of equipment and spares needed for oil-seed processing industry.

40.2 Co-operation envisaged through:

i. compilation of information on manufacture of equipment spares in developing countries;

ii. assistance in strengthening research and development capabilities, sharing of experience in training and in selection of technologies;

iii. study of modern harvesting techniques.

41. Food-Processing Industry

41.1 Problem areas:

i. lack of processing technology and know-how;

ii. difficulty regarding access to technological developments in other countries;

iii. shortage of information or the capability to evaluate and select necessary technologies.

41.2 Co-operation envisaged through:

i. collection and diffusion of information on suitable technologies and related know-how, and assisting developing countries in setting up national and regional technological information units;

ii. studying technological perspectives in food industry and their implications to developing countries;

iii. assisting developing countries in negotiations on transfer of technology through the preparation of a checklist of specific elements for inclusion in agreements;

iv. establishing special programmes to strengthen existing national and regional research and development centres as well as training services, and where appropriate establishing new ones.

42. Leather Products Industry

42.1 Problem areas:

i. lack of technology to process raw materials;

ii. lack of design and development facilities.

iii. co-operation in establishing joint design and development centres.

43. It will be seen from the foregoing that the sectoral consultation meetings arranged by UNIDO have helped in identifying several technological and other problems inhibiting growth of those sectors of industry in the developing countries and in suggesting co-operative arrangements for accelerating technological and industrial development of developing countries.

44. The consultation meetings have in particular served to highlight the crucial role played by information system and design and development capability. It has, among other things, revealed the need for a new type of information system which would combine technological, economic and commercial information, which could provide an important stimulus to the work already being done by the Industrial and Technological Information Bank (INTIB) of UNIDO.

45. It has also served to reiterate that the information system to be of practical value, is required to be related to the specific needs and particular sectors. For example, as brought out in the consultation meetings, the information needed by the developing countries in the field of capital goods industry, is concerning specific technological alternatives, their availability, results, costs and commercial conditions for acquisitions, as well as assistance in preparing a comprehensive list of suppliers of technology and potential parties among the small and medium scale enterprises. This type of information can help the decision maker in practical project formulation and implementation. In the food processing industry information required is concerning access to suitable technologies and related know-how as well as the terms and conditions for the acquisition of technology with particular emphasis on pricing, and on transfer of technology, including technical aspects such as level of production, magnitude of investments, inputs and infrastructure which could be a significant aid to individual developing countries in bilateral negotiations for the transfer of technology. In the drugs and pharmaceutical sector it would be useful

to compile a directory of manufacturers and suppliers of 26 essential drugs and their intermediates with details and specifications including, where possible, the indicative prices, process details and design spefication. To cater to such specific needs of potential users the information collected will be required to be appropriately repackaged.

46. The consultation meetings have moreover served to reaffirm the growing importance of co-operation among the developing countries as well as between developed and developing countries. Some of the specific areas for such co-operation identified by the consultation meetings include the following:

i. Exchange of experiences on construction and operation of fertilizer plants (3rd Consultation on Fertilizer Industry);

ii. special programme of co-operation between industrialized oil and gas producing developing countries for the development of down stream petrochemical industries in other developing countries (2nd Consultation on Petrochemical Industry);

iii. strengthening of training programmes and research and development centres through co-operation between relatively more industrialized developing countries and other developing countries (1st Consultation on Food Processing Industry).

47. Against the background of the important conclusions and recommendations of the various meetings on ECDC and TCDC reviewed in the foregoing paragraphs as well as the issues thrown up by the consultation meetings it would be now appropriate to examine the specific steps UNIDO has already taken, through its Technology Programme and Technical Assistance Programme to initiate and implement specific programmes and activities for promoting and strengthening technological co-operation among developing countries for their mutual benefit. This is discussed in the following chapter.

CHAPTER III

SURVEY OF UNIDO ACTIVITIES FOR PROMOTING TECHNOLOGICAL CO-OPERATION AMONG DEVELOPING COUNTRIES

48. Taking into account the conclusions and recommendations of various meetings reviewed earlier UNIDO has already initiated and promoted a number of programmes, activities and mechanisms for bringing about greater co-operation among developing countries.

49. UNIDO recognized right from the beginning the crucial need for encouraging free flow of information about technology between the developing countries as an effective means of promoting closer co-operation among them. It was realised that collection and dissemination of information on alternative technologies already available in developing countries are the basic prerequisites for the selection and acquisition of the next type of technology. Towards this end, UNIDO's Development and Transfer of Technology Branch undertook the task of compilation of information on technologies which have been developed by the research and development institutes of various developing countries. Two volumes on this subject have been published which contain information on about 400 different technologies pertaining to diverse sectors such as construction, chemicals, textiles, energy, etc., and a third volume is under preparation.

50. In 1978 UNIDO set up the Industrial and Technological Information Bank (INTIB) through which it has sought to provide information needed for selection of technology on a goal-oriented basis. Information on alternative technologies is provided in two ways: by means of publications and through responses to specific inquiries concerning the selection of technology and related matters. INTIB has been concentrating on three aspects of information on technology choice: identifying and linking up with sources of information, identifying and meeting end-user requirements and generating information. Apart from this UNIDO generated documentation

is abstracted, maintained and distributed through the Industrial Information System (INDIS) data base and also in the form of publications. Information collected by the several parts of UNIDO is also maintained in the On-line Information Key (LINK) data base to be used for specific ad hoc purposes. The Link data base now contains over 7000 entries on institutions, inquiries received, technology suppliers and other related matters.

51. As a specific step for promoting the flow of information among developing countries INTIB has compiled and published a Directory of Information Systems and services in developing countries containing a list of 450 institutions from 95 developing countries.

52. As for individual expertise, a roster containing names of 400 experts has been prepared which is used for a dual purpose: (a) securing expert advice to INTIB and (b) developing market for direct employment of experts under contracts between them and employers in developing countries. An activity in regard to technological manpower in Africa has also been initiated as part of an exercise for compilation of a roster of experts available among developing countries.

53. UNIDO has also prepared a few technology profiles for the pilot operation of INTIB to provide answers to technological inquiries which would otherwise have been difficult and costly. A technology information profile on solar energy utilization has been completed and preparation of a similar profiles on fuel alcohols and solar salt production has been initiated. A catalogue of manufacturers of solar-energy equipment is also under preparation. Six information packages on technologies developed or adapted for developing countries have been compiled and advertised through UNIDO newsletter. Under the title 'How to Start Manufacturing Industries - Technological and Investment Perspectives' 70 profiles have been published in a loose leaf format.

54. With the support of the World Intellectual Property Organization (WIPO), UNIDO has created the International Patent Documentation Centre which is a major source of information on the validity of patents in any country. Under a co-operative arrangement with UNIDO, WIPO has prepared users' guides to the International Patent Classification for four sectors (iron and steel, fertilizers, agro-industries and agricultural machinery).

Strengthening of Network of Institutions

55. UNIDO's approach has been to promote networking on specific goal-oriented projects which have the potential for creating maximum impact in the short run. Specific examples of such co-operative activities being promoted by UNIDO include bipartite co-operation between Brazil and Kenya in regard to small-scale fermentors and tripartite co-operation between Brazil, Uruguay and Paraguay in different subject areas.

56. UNIDO has also been instrumental in promoting the World Association of Industrial Technological Research Organizations (WAITRO) and the African Association of Industrial and Technical Organizations (AAITO).

57. A feasibility study was prepared for exchange of information among developing countries' research institutes in regard to the on-going and planned research programmes and the experts involved. A beginning was also made with the compilation of a directory of research institutes which would be willing to co-operate with others. A similar directory of African Research Institutes has also been completed. The main research areas are agricultural machinery and implements, building materials and related industries, solar energy and food technology. A directory of research institutes working on the industrial conversion of biomass has also been initiated.

Advanced Technologies

58. UNIDO has taken up a major programme on technological advances in several important subject areas such as microelectronics and biotechnology. An International Forum on Technological Advances is also being planned. The programme is designed to increase the awareness, through early identification and assessment of technological advances and to promote appropriate action. The action would relate to the industrial and technological capabilities that the developing countries would need in order to be able to avail themselves of such advanced technologies where appropriate and feasible and the policy actions required to be taken by the governments of developing countries. UNIDO is developing several specific projects bearing in mind the nature of the technological advances and the type of practical action that would be most effective in each case. Further, on the basis of the recommendations of a group of leading scientists, a proposal has been formulated for the setting up of an International Centre for Genetic Engineering and Biotechnology (ICGEB). The centre, when it becomes operational, is expected to serve as a high quality institute where scientists and technologists from developing countries would work together on technological problems of common interest and concern to them such as energy and fertilizer from biomass, using in particular genetically manipulated bacteria, improved agricultural products using phytochrome genes, improved fermentation techniques, etc.

59. Other UNIDO activities include an expert mission being fielded to study potential microelectronics applications in selected developing countries, leading eventually to either a network of selective applications in developing countries or the setting up of microelectronics applications centres. A regional meetings on the implications of microelectronics for the ECLA region was held in June 1982.

60. An innovative project for setting up a permanent national team to monitor technology perspectives is being implemented by UNIDO in Mexico with a view to providing, in particular, inputs for industrial, technological and commercial policy formulation and for decision making on large industrial projects.

61. UNIDO is also chairing a working group under the aegis of the Administrative Committee on Co-ordination of the United Nations on the subject of early identification and assessment of new scientific and technological developments.

62. National level sensitization meetings have been held with scientists, technologists and officials in various developing countries as part of the technology perspectives programme.

63. An expert group meeting was held in Mexico in June 1982 in co-operation with the Economic Commission for Latin America (ECLA) at which the implications of advances in microelectronics for the Latin American countries were analysed and recommendations for action made.

64. UNIDO is also studying the feasibility of promoting the establishment of software houses in developing countries. Another important area in which UNIDO has taken certain initiatives is technology for the exploration and exploitation of the resources of the sea. A comprehensive study on the subject has been prepared.

Technology Flow

65. UNIDO has recognized that as a starting point for increased technology flow among developing countries, it is necessary to compile information on technological capabilities of developing countries. Attempts have been made to collect such information on technologies which are proven and successfully commercialized.

In the monthly UNIDO newsletter a special column "Inter-Link" is devoted to this subject. Information collected in this manner has been published in two volumes in Development and Transfer of Technology Series and a third volume is under preparation. The experience in compiling this information has revealed that nearly 400 technologies, largely concentrated in a small number of developing countries, are reported to have been developed and available for commercial exploitation. The major sectors covered are: mechanical engineering, construction, textiles, energy, food processing, chemicals.

66. In order to facilitate technology flow among developing countries, UNIDO has assisted projects for scaling down and adapting modern technology to conditions in developing countries. Some examples are technical implementation plans for metal production development units prepared for certain African countries. A manual on mini-hydro power stations has been prepared indicating ways of identifying the potential for developing mini-hydro power generation in a given area and the techno-economic aspects that would need to be examined before taking a final decision to set up the plant.

67. As part of its programme for encouraging commercialization of technology, UNIDO has promoted the establishment of pilot plants in certain areas. For example a pilot plant is being set up in the Philippines for the production of ethanol from cellulosic materials. A project has been formulated in co-operation with Organization of African States for optimization of technologies for gasification of agricultural wastes in four African States. The project also envisages the establishment of pilot plants and training of manpower in those countries.

68. UNIDO has also undertaken certain activities to promote plant level co-operation between small-scale industries of different countries and establish linkages between industrial research institutions and small and medium scale industries, particularly

in rural areas with a view to improving the technological performance of these areas.

Negotiating Power

69. Various steps have been taken by UNIDO to strengthen the negotiating power of developing countries and to assist them in the acquisition of the desired technology on reasonable terms. They include:

i. steps to strengthen and improve the regulation of technology imports;
ii. assistance in redrafting legislation on joint ventures to promote increased inflow of foreign technology and capital;
iii. organizing training workshops to strengthen negotiating capabilities;
iv. publication of case studies in the acquisition of technology and guidelines for negotiations;
v. arranging special advice and assistance under the technological advisory services programme to assist developing countries in contract negotiations.

70. By far the most important activity initiated by UNIDO to strengthen the negotiating power of developing countries vis-a-vis developed country technology suppliers is the Technological Information Exchange System (TIES). It has enabled interested developing countries who have become members of TIES to exchange information on terms and conditions of technology contracts. Access to this information storehouse consisting of some 560 contracts. A TIES newsletter is also published regularly containing information of mutual interest to developing countries on matters concerning legislation, technology contracts, technology trends etc. At present 28 developing countries are associated with TIES as participants/observers and the number is steadily on the increase. Information is provided on a reciprocal basis whereby only a country which supplies information is entitled to receive information. TIES has also been strengthened by establishing co-operative links with regional technological information systems such as the Andean Technological Information System.

71. Technology acquisition problems are also discussed with technology suppliers in the sectoral meetings organized under the system of consultations. Meetings between TIES members and Licensing Executive Society (LES) are organized from time to time to enable them to collectively discuss problems of technology negotiation and acquisition.

72. UNIDO holds periodic meetings to review technology acquisition trends and suggest ways and means for strengthening technology transfer registries in processing and maintaining information. Steps are presently being taken to further strengthen the TIES system, to enlarge its membership and improve the quality of its service.

73. TIES is thus playing a positive and valuable role in assisting developing member countries to acquire required technology on more favourable terms by strengthening their negotiating capacity vis-a-vis the developed countries and by motivating them to adopt. suitable legislative and other measures for the regulation of technology imports. Experience gained from the TIES has shown that regulatory institutions, wherever they exist, have helped to restrict the size of payments for transfer of technology and eliminate/minimize restrictive clauses from technology contracts.

CHAPTER IV

A SUGGESTED PROGRAMME OF WORK FOR TECHNOLOGY PROGRAMME

74. Without underestimating the significance and value of the substantial amount of highly useful work that has already been done in promoting and strengthening technological co-operation among the developing countries and the relevant on-going programmes initiated by UNIDO and the regional groupings in Asia, Africa and Latin America in that regard, it must nevertheless be recognized that a number of specific issues and problems still need to be considered in greater depth and detail. Suitable action-oriented programmes and activities have to be initiated in order to streamline and intensify co-operative efforts among developing countries with a view to building up endogenous technological capabilities and collective self-reliance. This is altogether necessary to enable developing countries accelerate the process of their industrial and technological development and achieve the Lima target of 25% of global industrial production by the year 2000.

75. In the first place in order to create optimum impact it would be advisable to concentrate efforts and attention on a few strategic areas which are of vital concern to developing countries for achieving their developmental goals and social objectives. Some broad areas of priority concern have been indicated in the Caracas programme and by the New Delhi meeting of Heads of Science and Technology Agencies. These include health care and nutrition, energy development, industrial technology, chemicals and fertilizers, transportation, communications, low-cost housing etc. To these could be added some areas which form the subject of sectoral consultations such as capital goods, drugs, pharmaceuticals, food processing etc. Within these broad areas, concrete co-operative programmes and activities need to be initiated and suitable procedures, methodologies and mechanisms evolved for their implementation. These could be

conveniently discussed under the five main constituent elements of technological capability.

i. Information;
ii. technology flow;
iii. advanced technologies;
iv. technological services; and
v. negotiating capacity.

Information Collection and Exchange

76. As seen earlier, it has been stressed over and over again in various forums that one of the main factors inhibiting greater Technological Co-operation Among Developing Countries is the inadequate awareness of the technological capabilities of other developing countries. Apart from the fact, that due to certain historical reasons, enterprises in developing countries continue to display a marked predisposition in favour of technologies from highly industrialized countries even in respect of relatively unsophisticated production processes for which appropriate technologies are readily available within the developing countries, the chief reason for their persistent northward tilt is, without doubt, the lack of knowledge about what other developing countries have to offer and lack of confidence in the technical feasibility and commercial viability of developing country technologies. It is, therefore, necessary to take concrete measures to create keen awareness of the engineering and technological capabilities existing in developing countries and to generate necessary confidence in the technologies developed by them.

77. As a first step in this direction it is necessary to systematically compile and maintain inventories of significant technological capabilities developed by different developing countries. The information will need to be collected on different aspects of technological capabilities viz. information on technologies already developed and successfully commercialized, information on technological and engineering expertise available, information on research and

development facilities (both in the private and public sector) and information on research in progress or planned, information on consultancy and engineering services etc. This would be a major exercise involving considerable organized effort.

78. The information sought to be collected, compiled and disseminated would be of practical value only if it is relevant to the felt needs of developing countries and relates to the particular sectors/areas which are of priority concern. Annex II of the report gives the subjectwise order of priority drawn up by the meeting of Heads of Science and Technology Agencies of developing countries in May 1982. Since technologies are developed not only by research and development laboratories but also by in-house research and development facilities existing within production enterprises, both in the private and in the public sector, information on technologies developed by such 'captive' facilities will also need to be compiled.

79. A suitable mechanism and procedure is, therefore, required to be developed for systematic identification and use of such technological capabilities and expertise. Three steps would be involved in such exercise:

i. designing standard format or questionnaire for collection of information;

ii. screening of the information to evaluate its authenticity, relevance and utility;

iii. disseminating the information through appropriate channels to the end users.

A suggested format for information collection has been devised and appended to this report (Annex IV).

80. The meeting of Heads of Science and Technology Agencies has designated particular agencies in developing countries (Annex I) to act as focal points. These agencies should be requested to take up the responsibility for collection as well as screening and evaluation

of information collected through the questionnaire. The quality of responses received from different research and development institutions and productions enterprises as regards their technological capabilities and expertise is, however, bound to be uneven. The agency designated as the focal point will have to carefully evaluate the responses to the questionnaire before the information is considered suitable for inclusion in the inventory. The focal point will also have to assume the responsibility for continuously updating the information through a system of periodic reviews and monitoring. The focal point may be requested to associate the local UNDP Resident Representative or the Senior Industrial Development Field Adviser with the evaluation process and assist in the task of screening the responses.

81. On the basis of the information so obtained, it will be necessary to compile Sectoral Technology Directories - each directory covering a priority area of common interest to developing countries. Preparation of such sectoral directories of technological capabilities should, therefore, be one of the major exercises of UNIDO Information System. To begin with the information directories should cover the following industrial sectors or sub-sectors:

i. iron and steel;
ii. fertilizers;
iii. power projects;
iv. renewable sources of energy;
v. agricultural machinery and implements;
vi. drugs and pharmaceuticals;
vii. communications;
viii. biotechnology;
ix. microelectronics;
x. low cost housing;
xi. communication systems;
xii. marine technologies.

Each sectoral directory should have a separate section containing information regarding institutions or enterprises possessing capability to design and manufacture machinery and equipment and construct plants relating to that sector.

82. Apart from the sector-specific information collected and compiled in the form of sectoral directories, user-specific information will need to be collected and repackaged to serve particular user needs. Such information packages should cover the following aspects in respect of selected industries/projects:

- availability and nature of alternative technologies;
- commercial and other terms for acquisition of alternative technologies;
- type of technical assistance in the form of training of manpower etc. available, as part of the technology transfer arrangement;
- magnitude of investments, raw material inputs and related information that may be needed for a project of a particular scale and involving particular technology;
- sources of capital goods and equipment as well as technical services.

This type of information could be more usefully provided in the form of concise technology profiles on selected industrial projects as elaborated in a subsequent paragraph. In order to ensure that all relevant technological and allied information is contained in a technological profile it would be useful to devise a standard format. A suggested format of a technological profile is given at Annex VII of this report.

83. Drawing upon the experience gained through the consultation as well as other meetings, some of the specific items on which information would need to be compiled are indicated below:

i. information on alternative technologies and techniques, including coal gasification processes, which might replace coking coal by other fuels in iron and steel manufacture;

ii. information on alternative processes, plant and equipment for constructing fertilizer plants;

iii. industry-wise information on contracting terms and conditions;
iv. information on institutions and enterprises engaged in design and manufacture of fertilizer plants, agricultural machinery, mini steel plants etc.;
v. information on technological developments and technical and commercial aspects of solar energy utilization as well as information regarding solar energy equipment manufacturers;
vi. information on consultancy and engineering capabilities in different industrial sectors.

84. Apart from information on technologies developed and technological alternatives available in developing countries, there is need to compile information on expertise and skills in the form of highly qualified technical and engineering experts available in the developing countries. This information will be required to be collected and arranged according to areas of specialization in particular sectors or disciplines which are of priority interest to developing countries. This is by no means an easy task as the quality of information emanating from different sources and different countries is bound to vary considerably just as the technical competence and engineering skills available in different countries are of differing degrees of sophistication. Hence, the need for an effective machinery for systematic identification and screening of the information received and a mechanism for its storage, updating and dissemination.

85. The identification and screening exercise could be more effectively performed only at the national level through the agencies designated as focal points or an existing Governmental organization in charge of personnel selection and evaluation. The concerned agency will have to set up a mechanism such as an inter-departmental committee to screen the responses and weed out cases not suitable for inclusion in the roster of experts. The screening machinery will also have to formulate suitable norms or criteria such as basic academic qualification, length of experience in a particular area of specialization, contribution to research and development, association with professional bodies, publications or patents to credit,

awards and prizes secured for research or commercialization activity, consultancy assignments completed or in hand etc., to enable it to decide whether an individual in suitable for being registered as an expert in a particular area of specialization or not. In order to be able to collect the relevant information, a suggested proforma has been devised (Annex V), which could be circulated to national focal points for collecting and furnishing the information.

Networking of Institutions

86. Networking of institutions engaged in scientific and technological research and development has been found to be a useful method of exchange of scientific and technological information and of resolving specific technological problems through co-operative efforts.

87. However, networking to be really effective has to be promoted in respect of specific goal-oriented projects. It would for instance, be highly useful for UNIDO to assist in the establishment of networking among selected institutions in developing countries which have achieved a certain degree of excellence in specified areas of research and development such as utilization of solar energy, gasification of coal, production of basic drugs and vaccines, development and production of high protein crops, exploration and exploitation of resources of the sea such as, hydrocarbons and minerals. Experts from such institutions should be brought together in a workshop to review the state of the art in the respective areas, the progress achieved, the problems encountered and to suggest ways and means for developing countries to achieve accelerated development in those areas through networking. The directories of sectoral technological capabilities that are to be compiled will be useful in identifying the institutions which have acquired a relatively high degree of maturity and competence in selected areas and to establish networking arrangements.

88. Another key area in which networking could be usefully promoted is among design, consultancy and engineering organizations specialized in selected production sectors such as fertilisers, steel, machine tools, power generation, cement, petrochemicals, synthetic fibres, etc. It will be useful to arrange meetings under UNIDO forum for bringing together experts representing consultancy organization as well as representatives of the related manufacturing sectors for exchange of views and for identifying the consultancy organizations in respect of whom twinning or networking arrangements should be brought about in order to pool and share the available expertise and complementarities for achieving collective self-reliance.

89. Another area in which developing countries can co-operate more actively is in the formulation and execution of research and development programmes and projects which are of common concern to several developing countries, but for which they individually have neither the resources nor the capacity. It has to be remembered that no single country, much less a developing country, can on its own afford to cover the entire spectrum of technology. Moreover, many areas of research are of a transnational character. Often the cost not only of research and development but of the transition to industrial production is exceptionally high, and domestic market is relatively small, rendering international co-operation almost inevitable. Also a number of technologies such as, corrosion prevention technology, food preservation, etc. affect a wide range of industrial sectors. In such areas joint research and development could be taken up usefully by selected developing country research and development institutions, through appropriate tie up arrangements. The following institutional arrangements will be necessary for undertaking joint research programmes:

i. setting up of an Intergovernmental Science and Technology Committee;
ii. identification of a selected number of research projects in which a number of developing countries are interested;
iii. designating certain institutions in developing countries to act as the lead institutions for executing/co-ordinating particular research projects;
iv. arrangement for joint funding of the research projects by interested parties as per a mutually agreed formula;
v. pooling and sharing the research findings.

90. In some cases it would be advantageous to undertake joint research and development through the establishment of new International Centres in selected technology groups. The proposed establishment of an International Centre for Genetic Engineering and Biotechnology (ICGEB) is a major step in this direction. There is also a valid case for setting up international centres for microelectronics and for technologies for the exploration and exploitation of the resources of the sea.

Technology Flow

91. For facilitating and improving technology flow among developing countries various measures are necessary. In the first place there is need for launching a confidence building exercise by making developing countries aware of successful transfers of technologies that have already taken place between some developing countries and others. UNIDO should undertake the preparation of a portfolio of case studies analysing the experiences of the recipient countries in the successful acquisition and absorption of technologies from other developing countries and the manner in which they have contributed to enhancing their technological capabilities and industrial development. The study should also include cases of unsuccessful technology transfers with a view to clearly identifying the key factors which contribute to the success or the failure.

Creating and Strengthening Consultancy and Engineering Services

92. Not enough attention has so far been devoted to the role of played by consultancy and engineering services in facilitating technology flow from developed to developing countries and among developing countries as well as in strengthening the negotiating power of developing countries vis-à-vis developed country suppliers. In view of the crucial importance of Consultancy and engineering services in promoting industrial and technological development, this subject is examined in some considerable detail hereunder.

93. Consultancy services is a comprehensive term which encompasses a wide spectrum of activities. Broadly they fall into four categories: Technology Services such as surveys of natural resources, availability and suitability of raw materials, application of technical know-how to achieve product improvement and process improvement,

plant layouts, equipment selection, design and specifications, etc.
Design and Engineering Services such as project and plant design, preparation of documentation to tender for equipment or civil engineering, evaluations of bids, supervision in the erection of physical facilities or in start up operations.
Economic Services such as development planning and surveys of economic potential, project analysis, financial services and banking studies.
Management Services such as production planning and control, inventory planning and control, material handling, marketing, manpower training and development, etc.

94. Consultancy services can also be classified on the basis of the different stages of the project's evolution, viz.

(a) Pre-investment services, e.g. feasibility, evaluation and market studies;
(b) Project implementation services, e.g. choice of technology and equipment;
(c) Production and management services, e.g. trouble shooting, quality control and maintenance, etc.

95. The above types of services are provided generally either by established consultancy organizations, research institutions, universities or by outstanding individuals. Only a very few oragnizations however possess the capacity to provide the full range of consultancy services. Most specialise in selected areas. For providing a comprehensive package of services, consultancy organizations often resort to sub-contracting and talent sharing which gives them access to the kind of facilities and expertise which is not available in-house.

96. UNIDO had convened an expert group meeting at Ljubljana, Yugoslavia in June 1978 to discuss the role of industrial consultancy in developing countries. The meeting had highlighted the valuable contribution consultancy organizations can make to industriaization of developing countries by evolving appropriate technological and economic solutions through securing technology on improved terms and in achieving technical and managerial self-reliance

through a more effective use of national resources. Consultancy was recognized to be a key element in industrialization right from preinvestment to production and management stage. It is the 'Software' component of capital goods which is the essential hardware input for industrialization.

97. Several significant advantages of domestic consultancy and engineering services have been cited by those who have been intimately associated either with managing consultancy organizations or using their services.[1/] Some of the important benefits are:

(i) More appropriate technology choice

Consultancy and engineering organizations, because of their knowledge of alternative sources of technology and their capability to evaluate applications of alternative technologies in differing country situations, assist in the selection of technologies which are appropriate in a given context of factor endowments and constraints.

(ii) More efficient technology acquistion

Because of their expertise in technology assessment and evaluation and knowledge of local industrial and technological capability, they can assist in disaggregation of foreign technology packages and in identification of those technology components which need to be imported and those which can be locally procured. This helps minimise foreign exchange outflow and maximise local contributions to technological and engineering inputs, equipment, skills, etc.

(III) Linkage with local research and development

Domestic consultancy and engineering organizations can play a catalytic role in stimulating research and development activity by providing information on areas of relevant research and development to local institutions. They also encourage the utilisation of local research and development in the production sector through its commercialisation.

1/ Kan D. Mariwalla, Consultancy and Engineering activities in developing countries and their role in economic and industrial development, ID/WG.278/1 dt. 2 June 1978.

(iv) Adaptation and absorption of technology

Local consultancy and engineering organizations can provide the requisite skills for modifying and adapting foreign technology evolved under a different set of conditions, to suit local requirements and constraints. In view of their considerable project experience and knowledge of local conditions they can also make effective recipients and diffusion agents of imported technology.

98. Yet, despite these obvious advantages, domestic consultancy and engineering services continue to remain a weak link in the developing countries' infrastructure. Barring in a few relatively more industrialized developing countries, there is still heavy dependence on developed country industrial consultancy organizations with all their attendant adverse effects.
A number of factors are responsible for the inadequate development of consultancy services among the developing countries. Lack of specialization, inadequate financing, poor knowledge of management techniques, low engineering fees, lack of credibility, etc. Also because of the widespread tendency in developing countries to go in for ready-made turn-key solutions, the demand for domestic consultancy services remains generally stagnant.

99. There are however some developing countries who have sought to systematically promote, encourage and strengthen domestic consultancy and engineering services through provision of a package of financial incentives and adoption of helpful legislative measures. Some countries have enacted legislation prescribing domestic engineering firms as prime contractors for domestic plant construction except in cases where there are major technical inadequacies. This is often coupled with incentives such as tax and credit concessions, creation of funds for supporting domestic engineering services in times of hardship caused by sagging demand and so on. There is now a growing realization among the developing country governments that the creation or strengthening of indegenous industrial consultancy, including economic, technological, engineering, financial and management services, is essential for meeting the growing need for the

implementation of the programme of industrial and economic co-operation and development, and they are trying to take suitable measures in that direction.

100. Most domestic consultancy services in the more developed among the developing countries are independent organizations in the public or private sector which render services to many different customers. This is greatly beneficial to the customers as they do not have to keep large technical staff, which may be idle part of the time. On the other hand, consultancy organizations get the opportunity to acquire a wide range of information, experience and knowledge through carrying out assignments for a variety of clients. In the process they become important agents of diffusion of knowledge and skills.

101. In some developing countries the public sector controls important sectors of the economy such as electric power, transport, steel, oil and petrochemicals. They have a steady need for consultancy and engineering services and tend to have their own consultancy capacity; independent local consultancy organizations are used to supplement this capacity when peaks of activity take place, while foreign consultants are often employed as suppliers of basic engineering and highly specialised services.

102. The size of private independent consultancy organizations in developing countries varies considerably ranging from very small firms with high mortality rates to large stable firms. In many developing countries there are several small consultancy organization who carry out basically only preinvestment services and a limited number of engineering services. They are generally plagued by numerous problems such as instability of demand and lack of confidence in the effectiveness of their services. Often the clients who use such services are not exactly aware of what they want and may not be able to control the different stages of execution of a project. However, in some developing countries there are small groups of able professionals who are sometimes joined temporarily by outside experts for a specific project. Some of the good group consultancy units come to acquire sound

mastery of the technology of consultancy, develop excellent knowledge of local conditions and keep a dynamic system of contacts with users in the private and public sectors as well as with local and foreign sources of technology and equipment.

103. In some developing countries, ex. India and Brazil, there are relatively large private consultancy firms who possess the ability to handle complex projects on their own. Frequently they also operate as contractors and carry out turnkey projects for their clients. However, in many developing countries there is a proliferation of individual consultants and small consultancy firms coexisting with some state organizations and a few large private consultancy firms that are often foreign owned or joint ventures.

104. Developing countries which lack adequate industrial consultancy capacity tend to rely on foreign consultancy firms for devising investment projects or for improving industrial production and management. This however can have several undesirable consequences.

105. It has been found that consultancy organization from developed countries are not generally fully aware of the conditions and needs of developing countries for which they design investment projects. They tend to transplant solutions found effective in developed countries in a developing country environment where they may not be quite appropriate or relevant. What is worse, such solutions tend to favour purchase of technology, equipment and production inputs from the home country of the Consultancy organization. The possible supply of certain inputs from the recipient country is not generally taken into account. On the other hand, when consultancy and engineering services are carried out by competent domestic organizations with sound knowledge of local conditions, the potential benefits to the recipient country can be quite sizeable. Technological solutions can be more appropriate, absorption of foreign technology more efficient and investment packages can be more clearly delineated. There is also a possibility of reduction in the cost of projects and their

foreign exchange component, because local consultancy services are often cheaper and there is a higher proportion of local inputs than with foreign based services. 2/

106. Developing countries lacking adequate domestic consultancy services are now increasingly coming to realise that for enhancing their self-reliance in industrial and technological matters, it is imperative to build up necessary internal consultancy capacity. Experience of other countries possessing developed consultancy services has shown that they can lead not only to better project preparation through better appreciation of local conditions and more intensive utilization of local inputs of material, technology and skills but also to improved bargaining power with foreign suppliers of technology and equipment.

107. Generally, the task before consultancy organizations in the developing countries is much more onerous and challenging than in developed countries. The factor endowments required for the project and the scale of the project itself may not conform to any ready-made model. The information base is generally small and technology undeveloped. Indegenous capital goods industry may either be non-existent or underdeveloped. Research and development institutions may lack the necessary facilities and competence and expertise and skills may be quite deficient. However, such institutions and resources are more developed in some other developing countries such as Brazil, India, S. Korea, Mexico which could provide the necessary assistance to others, particularly in view of the fact that they would have themselves gone through similar experiences under similar conditions of development. Hence, in this area there is considerable potential for south-south co-operation. Also taking advantage of their respective comparative advantages and complementarities it is possible for two or more developing countries to adopt a consortium approach and provide the total package of technology, consultancy, engineering and project design services as well as equipment and construction materials. It would be useful to carry out studies of a few cases where such consortium approach has been successfully tried out.

2/ Alberto Araoz (ed), Consultancy and Engineering Design in Developing Countries, Ottawa, Ont., RDRC, 1981.

108. Developing countries need to take appropriate measures to develop and strengthen consultancy capability, both nationally and sectorally, bearing in mind the priority areas identified by the New Delhi meeting of the Heads of Science and Technology Agencies. Some of the industrially more developed countries such as Brazil, Mexico, Argentina, Republic of Korea and India have relatively well-developed consultancy and engineering capability both in certain specialised areas as well as comprehensive consultancy services. These countries have some large private as well as public sector consultancy organizations which are capable of handling complex projects on their own. Frequently, they carry out turn-key projects for their clients. Some of them are subsidiaries or joint ventures of consultancy organizations from industrialized countries. At the same time, they have a large number of small consultancy organizations and individual consultants who are capable of providing only the basic preinvestment services. Only a few organizations possess the capability to provide process and technological consultancy services; most are capable of only providing general economic and management consultancy services. There is thus an urgent need both to build up consultancy and engineering services where they do not exist and to strengthen and broaden the range of such services in other cases. To a large extent this objective could be achieved by developing mechanisms for effective co-operation among the developing countries themselves. Developing countries who have acquired expertise and experience in this field would be in a position to share them with others who are on the threshold of starting the process of industrial and technological development and relative services.

109. Two main constraints inhibiting development of co-operative programmes and activities in the field of consultancy and engineering services are the lack of adequate information regarding existing consultancy and engineering capabilities in different developing countries and lack of credibility in their competence. Information on existing consultancy services in different developing countries is required to be systematically collected, compiled and disseminated for the benefit of all developing countries. The information to be of practical value to developing countries will need to be organized on sectoral basis, such as consultancy and engineering

capability in respect of fertilizer plants, cement plants, power projects, heavy electricals, pharmaceutical plants, steel plants, processing and canning of fruits, vegetables and fish, solar energy, coal beneficiations, transport vehicles, communications equipment and so on. Relevant information will have to be collected and repackaged in respect consultancy and engineering organizations in developing countries who are specialised in particular areas or sectors as also in respect of those who are able to undertake comprehensive consultancy assignments covering a number of diverse areas or disciplines. The degree of expertise and experience the consultancy organizations possess in terms of highly professionally qualified staff, contacts with diverse sources of information and technology, links with research and development institutions, universities, chambers of commerce and industry, equipment manufacturers', financial and developmental instituions, etc. as well as the types of consultancy and engineering assignments they have already successfully completed and the assignments they have in hand, etc. would be important factors in assessing and determining their maturity and competence to handle different types of consultancy assignments. In the first instance it will be necessary to design a standard format for collecting such information regarding consultancy and engineering organizations existing in different developing countries. The designated national focal points should be the medium through which the format is distributed to consultancy organizations and the responses obtained should also be initially screened by them. On the basis of the information received through the focal points UNIDO secretariat should compile directories of consultancy organizations in selected sectors which are of interest and concern to several developing countries. A suggested format for obtaining the necessary information has been devised and appended to this report (Annex VI).

110. For strengthening consultancy organizations and promoting effective co-operation among the developing countries some specific steps will have to be taken.

1. Important areas in which consultancy and engineering services need to be developed and shared will have to be identified. These could include sectors such as electric power, alternative sources of energy, steel, petrochemicals, fertilisers, transport,etc.

(ii) Promotion of effective relations between consultancy organization and research and development institutions, equipment manufacturers, input suppliers etc.

(iii) Formation or strengthening of associations of consultancy organization at the national, regional and interregional levels for raising professional standards through establishment of codes of conduct, exchange of experience and improved communication channels.

(iv) Promoting twinning or networking arrangements among consultancy organizations of similar specializations and objectives, thus intensifying activity and enlarging experience in the same area such as for example designing thermal power plants or fertilizer plants.

(v) There could also be effective co-operation between consultancy organizations specializing in complementary fields such as plant design and plant erection. This could take the form of joint ventures.

(vi) Gaps in capability existing in consultancy organizations in developing countries may be filled through co-operation among developing countries or through co-operation with consultancy organizations in developed countries, if necessary.

(vii) There is scope for geographical or substantive specialization in particular areas in view of the varying requirements of different countries as well as general scarcity of resources.

111. Co-operation among developing countries in promoting and strengthening consultancy and engineering services could be brought out through different mechanisms such as the following:

A group of manufacturing enterprises in different countries could jointly promote consultancy services in certain key areas of common interest. For example, a group of fertiliser manufacturing companies in different countries could jointly set up a consultancy and engineering organization that will be capable of providing a complete array of services including preinvestment feasibility, market studies, advise on the selection of process technology and equipment as well as assistance in trouble shooting, quality control, maintenance, etc. Manpower and funds required for setting up the consultancy

organizations could be drawn from the promoter enterprises. There will have to be a common board of management which would approve the work programme and make allocation of funds for different projects. Such consultancy organizations should provide their services not only to the promoter enterprises but also to prospective new clients and entrepreneurs in other developing countries who either lack such services altogether or are deficient in them. Such joint ventures could also assist other countries in establishing or strengthening their own consultancy and engineering capabilities through technical assistance, etc.

112. On a similar pattern, in certain key areas such as generation and transmission of power, authorities or boards concerned with power generation and transmission of a number of interested developing countries could come together and establish a specialised consultancy and engineering organization that could assist developing countries in making surveys, designing power plants, negotiating with technology and equipment suppliers, erecting the plants, overseeing their management and maintenance, etc. A multinational consultancy agency can thus be established with financial and technical participation by a group of interested countries which could provide services on commercial basis to all interested developing countries.

113. Yet another mechanism could be inter-country complementary specialisation whereby a few selected developing countries which have achieved a high level of sophistication in consultancy and engineering services in particular areas such as iron and steel, transport equipment, agricultural machinery, pharmaceuticals, plant design, plant erection, etc. could join together in or co-operative network for assisting one another as well as other developing countries by providing them such specialised services not only to develop their own indegenous capabilities but also to assist them in negotiations with developed countries for purchase of technology, plant and equipment, etc. As an example of this type of co-operation one can mention the case of Bharat Heavy Electricals Ltd. (BHEL), a leading Indian public sector

enterprise manufacturing sophisticated power generation equipment which is assisting Turkey in negotiations with a developed country for collaboration in the manufacture of transformers.

114. It is also necessary to establish or strengthen networking among consultancy and engineering organizations of different developing countries which are specialised in certain key areas, for providing consultancy expertise and sharpening existing skills.

115. Twinning arrangements for pooling complementary capabilities of local consultancy firms with sister organization from another developing country for joint work on project-to-project basis can also be promoted for strengthening indigenous capability. In this manner development of local industrial consultancy can lead to sectoral co-operation among developing countries. In other words, concerned organizations for two or more developing countries could join hands, each providing a part of the input to make total package of technology, consultancy, engineering and project design services as well as equipment and construction materials. UNIDO could include several other specific activities in its work programme to strengthen domestic consultancy and engineering services in the developing countries as well as to promote and intensify co-operation among them for mutual benefit. Some possible activities are:

(i) Undertake a comparative study of legislative and other policy measures adopted by a few selected developing countries for strengthening national capability in consultancy and engineering services and evolve guidelines for other countries wishing to create or strengthen similar capability.

(ii) Organize sectoral workshops on consultancy and engineering services in respect of critical project areas such as power projects, fertiliser plants, plant and equipment for utilization of solar energy, manufacture of essential drugs, cement plants, etc. Participants in the workshops should be drawn from leading consultancy and engineering organizations as well as the manufacturing enterprises in selected developing countries. The output of the workshops should be to suggest practical steps to strengthen the consultancy infrastructure in the selected sectors through exchange of experience and expertise, networking arrangements, complementation arrangements, identification of possibilities for joint projects and programmes, etc.

Mechanism for regulating technology inflow

116. Indiscriminate import of technology from industrialized countries is one of the factors which has retarded indigenous technological research and development effort. Only a few developing countries have evolved effective mechanisms for systematically monitoring and regulating the inflow of foreign technology in national interest. It has been found that most of the technology being imported into the developing countries is developed by the transnational corporations which is not necessarily suitable to the particular needs of the developing countries. Also, such technology is often passed on to the developing countries on terms that are not conducive to their long-term interests. It is therefore necessary for all developing countries who are desirous of importing technologies to establish a mechanism for undertaking a thorough screening of technology contracts. It must be ensured that the technological services required are clearly specified and technology packages are unpackaged to admit indigenous technological and material inputs wherever feasible, that adequate provision is made for training of local manpower, that payment terms are not unreasonable and that unnecessarily restrictive clauses in regard to further dissemination of technologies, patents, export to third countries, etc., are not introduced. It is equally necessary to monitor the actual uses of imported technology in order to keep track of the state of technology development in priority sectors.

117. UNIDO should organize an international meeting of experts and policy makers from selected developing countries with considerable experience in regulating technology imports to discuss and compare national experiences regarding the effectiveness of existing technology regulating mechanisms and legislation with a view to evolving a model legislation and mechanism for regulation of technology imports for the benefit of all developing countries.

118. It would also be a useful exercise for UNIDO to undertake a compilation of information on technologies acquired by developing countries in identified priority sectors. Information already collected through TIES will need to be re-arranged sector-wise. TIES network will

also have to be considerably strengthened so that relevant information on the source of technology, type of technology and the terms and conditions on which technology in the priority sectors has been acquired by the developing countries is collected from as many developing countries as possible and disseminated on selective basis. A comparative study of the quantum and terms of payment for different types of technology and their effect on the project economics in different developing countries could be a particularly revealing exercise.

Commercialization of Technology

119. Another factor which has been inhibiting technology flow among the developing countries is the inadequate attention paid by developing countries to the commercialization of their research findings. Technology, to be of commercial value needs to be moved from the drawing board through the various stages of production and testing to final industrial process. Unless its technical viability and commercial feasibility are demonstrated a new research finding can be of little more than academic value. Commercialization requires development of capability in different areas such as process and product design, plant design, manufacturing operations, quality control, etc. The record of the developing countries in successfully commercializing the processes developed by their research institutions has not been particularly encouraging. Often the research findings made in developing countries are commercialized in developed countries and then transferred back to the developing countries, thus creating a triangular arrangement for technology transfer among developing countries. For quickening and facilitating technology flow from one developing country to another, developing countries must commercialize their own technology by acquiring the necessary capability in plant design, by setting up pilot demonstration plants, and prototypes, etc. It is customary among many engineering and chemical industries in some of the larger developing countries to set up pilot demonstration plants and prototypes before large-scale commercial production or series production is undertaken. It would be useful to compile an inventory of such pilot plant facilities available in developing countries. Developing countries which have done successful research and development in particular areas which are of common interest to other developing countries should be assisted in

establishing pilot plants which could be used as common facility centres by other interested developing countries. Some of the areas in which pilot plants-prototypes should be established are the following:

- Pilot plant for gasification of coking coal
- prototype of engine working wholly or partly on biogas and other fuels from biogas
- Pilot plant for production of solar cells
- Pilot plant for production of vaccines with the aid of genetic engineering

Technolgy Profiles

120. One of the effective ways in which transfer of technology can be facilitated is preparation of technology profiles on specific subjects of interest to a number of developing countries. Technology profiles can provide the prospective user concise information on all relevant aspects concerning the setting up of a production unit. Typically the information would relate to available technologies and processes for setting up the unit, the main items of equipment and raw materials needed and the sources from which they could be obtained, manpower required, the probable scale of investment, space, energy and utilities required, products and product costs, possible demand, sales and profitability. This type of techno-economic information, periodically updated, can be an invaluable aid to entrepreneurs or investors wishing to establish new projects.

121. UNIDO has already prepared a few technology profiles pertaining to certain industrial sectors such as iron and steel, fertilizers, agro-industries and agricultural machinery and implements. Apart from this UNIDO could build up a portfolio of profiles on specific projects and technologies which are urgently needed by the developing countries. The profiles should cover the priority areas already identified, viz., power, mineral resources survey, civil construction, fertilizers, transportation, etc. Since only a few countries possess the requisite capability to prepare such technology profiles, experts and institutions from countries possessing the capacity may be requested by UNIDO to draw up a comprehensive list of such projects and then undertake the preparation of

profiles on selected items. Some of the specific subjects in which technology profiles may be commissioned are:

1. Technological profile on steel rolling and strip mill
2. Technological profile on cement plant
3. Technological profile on mini-hydro power plant
4. Technological profile on sugar plant
5. Technological profile on manufacture of motorized two wheeler and three wheeler transportation vehicles
6. Technological profile on prefabricated building material plant
7. Technological profile on manufacture of diesel engines
8. Technological profile on manufacture of paper and paper products
9. Technological profile on production of power tillers and harvesters
10. Technological profile on manufacture of centrifugal pumps
11. Technological profile on a mini-steel plant
12. Technological profile on a pharmaceutical plant
13. Technological profile on processing medicinal plants

122. In order to ensure that all the relevant techno-economic information is contained in the technological profile it would be useful to devise a standard format of technological profile to be prepared by recognized experts, consultancy and engineering organizations or other concerned institutions. A suggested format has accordingly been prepared (Annex VII).

ENHANCING NEGOTIATING POWER

123. Even as systematic efforts to strengthen technological co-operation among developing countries continue to be made, it would also be necessary for the developing countries to individually as well as collectively strengthen their negotiating power vis-a-vis the suppliers of technology and equipment from the developed countries.

UNIDO could help in the process by:

(i) arranging training and exchange programmes in bargaining and negotiating skills for developing country personnel. UNIDO should organize short term training programmes (2 weeks or so) in countries with expereince and capabilities in the field, for participants from interested developing countries. The training programmesshould include training in methodologies for the disaggregation of technology and investment packages, technology import regulation, payment terms etc;

(ii) enlarging TIES network to include more developing countries to share information and knowledge on technology contracts;

(iii) drawing up model contracts in priority sectors which could serve as the basis for negotiations with developed country suppliers;

(iv) making comparative study of technology regulation mechanism and legislation in selected developing countries and evolving model legislation and guidelines for assisting other developing countries in framing appropriate legislation and mechanism for enahncing their negotiating capacity. This could be one of the important items to be included in UNIDO's work programme.

(v) strengthening the capacity to disaggregate technology packages and enabling developing countries to import only those components that they do not possess and using their domestic inputs whereever feasible. This will assist developing countries to switch over from the practice of entering into turnkey arrangements with developed country suppliers and enable them to provide considerable number of components of technology and raw materials from indigenous sources.

124. As part of its work programme, UNIDO should prepare studies of successful cases of disaggregation of technological and investment packages with a view to demonstrating the methodologies employed and the tangible benefits accured as a result of this exercise. Typical cases relating to areas such as fertilizer project, steel plant, pharmaceutical plant, transport and earthmoving equipment etc. should be covered by the study. A few comparative studies of turnkey vis-a-vis disaggregation models applied to particular industries should be prepared for dissemination to all developing countries. Efforts will be required to be made to intensify the capacity of the consultancy and engineering design organizations to differentiate between the core technology components which may have to be imported and the peripheral technology components which could be supplied by domestic engineering enterprises, and integrating various technology components obtained from different sources and evaluating and negotiating technology agreements and licenses.

125. The negotiating power of developing countries will be further enahnced if they develop the necessary skills and linguistic ability to negotiate with developed country suppliers through planned programmes of manpower development. Here again the expertise available in developing countries could be shared through exchange programmes among developing country manpower development and training institutions.

ADVANCED TECHNOLOGIES

126. UNIDO has already done considerable amount of work in the area of advanced technologies. Several activities have been initiated to study the implications of genetic engineering, microbiology and micro-electronics

for developing countries and a proposal for the establishment of an international centre for genetic engineering and biotechnology is being actively pursued.

127. The implications of these technologies for fulfilling the basic needs of the people of the developing countries such as food production and preservation, housing, transport and communications, energy, health and sanitation needs to be studied in depth on a sectoral basis. It would be a useful exercise if UNIDO organizes expert group meetings to analyse and identify those elements of such technologies which could create maximum impact in the solutions of problems which are of common concerns to all developing countries and to evolve policy grudelines, methodologies and programmes of action for enabling developing countries to build up the requisite capabilities in the areas which are of vital concern to each of them.

128. The New Delhi Meeting of Heads of Science and Technology Agencies has constituted an Action Committee on biotechnology comprising Algeria, Cuba, Egypt, Mauritius, Mexico, Philippines, Sudan, Venezuela and Zambia. It is necessary that UNIDO should establish and maintain close contacts with this Action Committee with a view to working out details of co-operative activities involving information, research and development, training, setting up of pilot plants etc. As a first step UNIDO should request the member countries of the Action Committee to elect a convenor and convene a meeting for discussing the subject in all its aspects. UNIDO could prepare a background paper for the meeting outlining the work it has already initiated in this area and suggesting a specific programme of action for the future. Certain new product ideas such as production of vaccines with the aid of genetic engineering, genetically engineered insulin and growth hormones, diagnostic kits based on monoclonal antibodies for use in medicine could also be taken up for further study to examine their implications for developing countries.

129. Another area which needs to be studied in greater depth is the technological aspects of the exploration and exploitation of the rich resources of the sea bed, particularly the hydrocarbon and mineral resources.

of
At present, only a handful/developed countries possess this technology while some developing countries such as Mexico and India have made a small beginningsin this sophisticated area. Some developing countries have set up new institutes to co-ordinate research and development activities in ocean development and mining. Since this is a highly important area of common interest to all littoral developing countries, but very few of them can afford to set up comprehensive indegenous technological capabilities, UNIDO should consider promoting the establishment of /an international Ocean Technology Centre for undertaking joint research and development in various technical and related economic aspects of exploration and exploitation of the resources of the ocean. Alternatively an existing oceanographic institute or centre in one of the developing countries could be developed into a centre of excellence with UNIDO assistance for providing research and training facilities to other developing countries as well as to undertake joint surveys and joint technology development programmes for the exploration and exploitation of the mineral and hydrocarbon resources of the ocean.

Action Committees

130. The New Delhi Meeting of Heads of Science and Technology Agencies of Developing Countries has identified specific science and technology areas (annex II) and also set up action committees to suggest specific programmes and projects in areas of mutual interest to developing countries (annex III). More specifically the action committees are expected to work out details of co-operative activities involving information dissemination, training and research and development programmes, consultancy services, setting up of pilot plants and industries and transfer of technology are the priority areas. The areas in which action committees have been constituted include energy development, health care and nutrition, food and agriculture, industrial technology, communication systems, marine resources, human resources development etc.

131. It is necessary for UNIDO to establish contacts with the convenors of the action committees with a view to assisting them through preparation of the basic documentation etc. that will be required for the meetings of the Action Committees. As a first step in this direction, UNIDO could undertake the

preparation of brief discussion papers on the subject areas in which the action committees have been set up focussing attention on the different dimensions of the subject, highlighting the work already done by UNIDO in each area,the problems encountered, the lessons drawn and indicating the programmes and activities that could be undertaken in the future. UNIDO's effort, though the preparation of such basic documentation should be to assist the Action Committees in identifying potentialities and mechanisms for concrete TCDC activities in respect of each priority area.

ANNEX I

FOCAL POINTS IDENTIFIED BY THE NEW DELHI MEETING OF HEADS OF SCIENCE AND TECHNOLOGY AGENCIES OF DEVELOPING COUNTRIES

AGRICULTURE

S. NO.	COUNTRY	FOCAL POINT
(1)	(2)	(3)
1.	Algeria	National Institute for Research in Agriculture.
2.	Bhutan	Agriculture Department. (Agriculture) Forestry Department. (Forestry) Animal Husbandry Department. (Animal Husbandry)
3.	Cuba	Cuban Academy of Sciences.
4.	Indonesia	Department of Agriculture.
5.	Republic of Korea	Office of Rural Development. Korea Advanced Institute of Science and Technology.
6.	Nepal	Ministry of Agriculture, MHG, Nepal.
7.	Nigeria	Federal Ministry of Science and Technology, Lagos, Nigeria.
8.	Sri Lanka	National Science Council. (to be renamed as Natural Resources Energy and Science Agency).

(1)	(2)	(3)
9.	Thailand	1. Department of Technical Agriculture, Ministry of Agriculture and Co-operatives, Bangkok. 2. Institute of Food and Products Research, Kasetsart University, Bangkok. 3. Faculty of Forestry, Kasetsart University, Bangkok.
10.	Pakistan	Agricultural Research Council.
11.	Venezuela	CONICIT, P.O.B. 60717, HOSRVICES, CZRACAS.
12.	Yugoslavia	Federal Committee for Agriculture.
13.	Zambia	1. Ministry of Agriculture and Water Development. 2. National Council for Scientific Research
14.	India	Ministry of Agriculture/ICAR/Agricultural Universities/CSIR/Deptt. of Environment.
15.	Kenya	National Council for Science and Technology.
16.	D.P.R. Korea	Commission of Agriculture
BIOTECHNOLOGY		
1.	Indonesia	1. Indonesian Institute of Sciences. 2. Agency for the Study and Application of Technology.
2.	Venezuela	CONICIT, P.O.B. 70617, CARACAS, VENEZUELA.
3.	Kenya	National Council for Science and Technology.
CHEMICAS AND FERTILISERS		
1.	Egypt	Ministry of Industry (including Biomass).
2.	Pakistan	PCSIR
3.	India	Ministry of Chemicals and Fertilisers.
4.	Kenya	National Council for Science and Technology.

(1)	(2)	(3)
COMMUNICATION SYSTEMS		
1.	Bhutan	Ministry of Communications.
2.	Egypt	Ministry of Communications.
3.	India	Telecommunication Research Centre. Ministry of Communications.
4.	Kenya	National Council for Science and Technology.
EDUCATION		
1.	Bhutan	Education Department.
2.	Cuba	Ministry of Education
3.	Egypt	Ministry of Education. (Adult Education and Technical Education)
4.	Nepal	Ministry of Education, MHG, Nepal.
5.	Venezuela	CONICIT, P.O.B. 70617, HOSRVICES, CARACAS.
6.	Yugoslavia	Federal Institute for International Scientific Educational, Cultural and Technical Co-operation.
7.	India	Ministry of Education/UGC/Deptt. of Science and Technology.
8.	Kenya	National Council for Science and Technology.
9.	D.P.R. Korea	Commission of Education.
ENERGY DEVELOPMENT		
1.	Algeria	Commissariat aux Energies Nouvelles.
2.	Bhutan	Department of Power.
3.	Cuba	Cuban Academy of Sciences.
4.	Indonesia	1. Bandung Institute of Technology. 2. Agency for the Study and Application of Technology.
5.	Republic of Korea	1. Office of Rural Development. 2. Korea Energy and Resources Research Institute.

(1)	(2)	(3)
6.	Nepal	Research Centre for Science and Technology, Tribhuvan University, Nepal.
7.	Nigeria	Federal Ministry of Science and Technology, Lagos, Nigeria.
8.	Sri Lanka	1. Ministry of Power and Energy. 2. National Science Council (to be renamed as Natural Resources Energy and Science Agency).
9.	Thailand	National Energy Administration, Ministry of Science, Technology and Energy.
10.	Pakistan	Ministry of Science and Technology.
11.	Yugoslavia	Federal Committee for Energy and Industry.
12.	Zambia	National Council for Scientific Research.
13.	India	DST/CSIR/Ministry of Education/UGC/IIT/ DAE/KVIC/ICAR/Deptt. of Power/Ministry of Industry/BHEL/Deptt. of Coal/EIL/ Ministry of Energy/Ministry of Petroleum/ ONGC.
14.	Kenya	National Council for Science and Technology.
ENVIRONMENT PROTECTION		
1.	Cuba	Cuban Academy of Sciences.
2.	Thailand	National Environment Board, Ministry of Science, Technology and Energy.
3.	India	Ministry of Works and Housing/CSIR/ Department of Environment.
4.	Kenya	National Council for Science and Technology.
HEALTH CARE AND NUTRITION		
1.	Algeria	Institute de Technical Medicales.
2.	Bhutan	Health Department.
3.	Cuba	Ministry of Public Health
4.	Egypt	Ministry of Health and Family Planning, Ministry of Provision.

(1)	(2)	(3)
5.	India	Ministry of Health/Agriculture/DST/ICMR/ CSIR/UGC/TIFM/Deptt. of Environment/ Deptt. of Education/IISc./IIT.
6.	Nigeria	Federal Ministry of Science and Technology, Lagos, Nigeria.
7.	Sri Lanka	Ministry of Health, National Science Council(to be renamed as Natural Resources Energy and Science Agency).
8.	Thailand	Department of Public Health, Ministry of Public Health, Bangkok.
9.	Pakistan	Ministry of Health.
10.	Venezuela	CONICIT, P.O.B. 60717, HOSRVICES, CARACAS, Venezuela.
11.	Zambia	1. WHO/Zambia Centre for Research and Training in Sea Diseases. 2. National Nutrition Commission.
12.	Kenya	National Council for Science and Technology.

INDUSTRY TECHNOLOGY

1.	Algeria	Institut National d'Edaduf et se ia Productivite Industrialla.
2.	Bhutan	Department of Industry and Mines.
3.	Cuba	Cuban Academy of Sciences.
4.	Nepal	Industrial Services Centre, Balaju, Nepal.
5.	Nigeria	Federal Ministry of Science and Technology, Lagos, Nigeria.
6.	Pakistan	Ministry of Science and Technology.
7.	Venezuela	CONICIT, P.O.B. 70617, HOSRVICES, CARACAS.
8.	Yugoslavia	Federal Committee for Energy and Industry.
9.	Zambia	National Council for Scientific Research.
10.	India	Ministry of Industry/DST/CSIR/Deptt. of Electronics/ICAR
11.	Kenya	National Council for Science and Technology

(1)	(2)	(3)
LOW COST HOUSING		
1.	Egypt	Ministry of Housing
2.	Thailand	Thailand Institute of Scientific and Technological Research
3.	Pakistan	Council for Housing and Work
4.	Zambia	National Council for Scientific Research
5.	India	Ministry of Works and Housing/DST/CSIR/ Ministry of Petroleum/Ministry of Education/IITs.
6.	Bhutan	Public Works Department.
7.	Venezuela	State Ministry for Science and Technology, Miraflores Palace, Caracas, Venezuela.
8.	Kenya	National Council for Science and Technology.
MODERN TECHNOLOGY		
1.	Pakistan	Ministry of Science and Technology
2.	India	DST/CSIR/ICAR/ICMR/Ministry of Education/ Indian Institute of Science/IITs/UGC
3.	Kenya	National Council for Science and Technology.
SCIENCE AND TECHNOLOGY POLICIES		
1.	Bhutan	Planning Commission
2.	Pakistan	Ministry of Science and Technology.
3.	Yugoslavia	Federal Committee of Energy and Industry in Co-operation with Federal Patent Institute and other relevant federal and republic/provincial authorities and bodies.
4.	India	DST/CSIR/DDE/all other related agencies.
5.	Kenya	National Council for Science and Technology.

TECHNOLOGIES FOR RURAL DEVELOPMENT

(1)	(2)	(3)
1.	Cuba	Cuban Academy of Science.
2.	Egypt	Ministry of Agriculture, Ministry of Social Welfare.
3.	Republic of Korea	Korea Advanced Institute of Science and Technology.
4.	Sri Lanka	National Science Council of Sri Lanka.
5.	Pakistan	PCSIR/AIDO
6.	Zambia	National Council for Scientific Research.
7.	India	Ministry of Rural Reconstruction/DST/ MVIC.
8.	Kenya	National Council for Science and Technology.

TRANSPORTATION SYSTEMS

1.	Bhutan	Ministry of Communication.
2.	Yugoslavia	Federal Committee for Transport and Communication.
3.	India	Ministry of Shipping and Transport, Ministry of Railways, DST/CSIR/Deptt. of Electronics/Deptt. of Defence Research and Development.
4.	Kenya	National Council for Science and Technology.

ANNEX II

PRIORITY AREAS IDENTIFIED BY THE NEW DELHI MEETING OF HEADS OF SCIENCE AND TECHNOLOGY AGENCIES OF DEVELOPING COUNTRIES

1. Health Care and Nutrition (130)
2. Energy Development (128)
3. Agriculture (124)
4. Technologies for Rural Development (122)
5. Education (114)
6. Industrial Technology (110)
7. Low Cost Housing (108)
8. Chemicals and Fertilisers (92)
9. Modern Technology (92)
10. Transportation System (85)
11. Resource Engineering (84)
12. Science & Technology Policies (84)
13. Communication Systems (76)
14. Environment Protection
15. Waste Utilization (68)
16. Biotechnology (20)
17. Marine Research (18)
18. Micro-Electronics (13)

(Figures in brackets indicate total score)

Note : Each delegate was asked for 4 priorities and the markings given to priorities are as follows :-

1. .. A - 10
   .. B - 8
   .. C - 6
   .. D - 4
2. Where serial numbers were allotted by respondents 1 to 4 = 10, 5 to 8 = 8, 9 to 12 = 6, 13 to 16 = 4
3. In all there were 17 countries which responded.

ANNEX III

ACTION COMMITTEES SET UP IN PRIORITY AREAS BY MEETING OF HEADS OF SCIENCE AND TECHNOLOGY AGENCIES OF DEVELOPING COUNTRIES, MAY 1982

No. (order of priority)	Area	Interested countries who have indicated highest priority	Action Committee Convener
	FOOD AND AGRICULTURE: (Food processing, Agricultural Machinery, Forestry, Irrigation, Soil conservation, Improved seed production, dry land farming, New Agronomy practices).	Algeria, Comoros, Cuba, Egypt, Kenya, Lybia, Madagascar, Mauritius, Mexico, Nigeria, Philippines, Thailand, Venezuela, Yugoslavia, Zambia. Guinea.	Philippines
	HEALTH CARE & NUTRITION: Operational research for improving health conditions, fertility regulation, control of communicable diseases, improvement of nutritional status of mothers and children, occupational health hazard, non-communicable diseases, health care delivery system, vaccine production.	Algeria, Cuba, Egypt, India, Kenya, Madagascar, Mauritius, Philippines, Venezuela, Zambia. Guinea.	Kenya.
	ENERGY DEVELOPMENT: Conventional energy conservation measures, renewable resources, development, solar biogas, wind, geo-thermal, etc.; Coal beneficiation.	Algeria, Cuba, Egypt, India, Kenya, Mauritius, Philippines, Sudan, Thailand, Zambia. Guinea.	India/Sudan
	SCIENCE & TECHNOLOGY POLICY: Planning techniques, Management of S&T, Technology Assessment, S&T and Economic Development.	Algeria, Kenya, Mauritius, Mexico, Thailand, Yugoslavia, Zambia.	Algeria
	BIOTECHNOLOGY: Enzyme Engineering, Tissue Culture, Fermentation Technology, Genetic Engineering, Immuno-technology, Photosynthesis, etc.	Algeria, Cuba, Egypt, Mauritius, Mexico, Philippines, Sudan, Venezuela, Zambia.	
	LOW COST HOUSING: Local building materials and their strengths, composite materials for buildings, cost-reduction through manufacturing techniques.	Egypt, Mauritius, Nigeria, Thailand, Zambia. Guinea.	Thailand

NOTE:

The identification of priority areas has been based on information received from 18 countries.

Priorities have been arrived at based on A, B, C, D, priorities given by Member-countries.

The conveners have been identified based on the offers made by individual countries. These countries are expected to take initiative in organising the meetings of the Action Committees based on guidelines given in the recommendations 10 and 11 in ITIF.

In the case countries had identified individual institutions for areas of interest, these could be finalised in subsequent stage.

7.	EDUCATION : Science and technology educational system, training facilities for technicians and engineers, health and agricultural scientists and technologists, training in emerging technologies, teacher training facilities, directory of experts, higher education in science, technology and engineering.	Algeria, Cuba, Madagascar Mauritius, Romania, Venezuella, Yugoslavia, Zambia.	Algeria
8.	CHEMICALS AND FERTILIZERS: Drugs, Pharmaceuticals, Petrochemicals, etc.	Egypt, India, Madagascar, Mauritius, Mexico, Thailand, Zambia.	India/
9.	TECHNOLOGIES FOR RURAL DEVELOPMENT	Kenya, Madagascar, Myanmar Mauritius, Sudan, Thailand, Zambia.	-
10.	MODERN TECHNOLOGY: Computer science and Technology, Informatics, Remote Sensing, Socio-economic impact studies, etc.	Algeria, India, Sudan, Venezuela, Zambia.	-
11.	MICROELECTRONICS: Semi-conductor technology, Integrated circuits (LSI & VLSI)	Egypt, Sudan, Thailand, Zambia.	-
12.	MARINE RESOURCES: Exploration and Utilization of Living and non-living resources.	Cuba, Mauritius, Philippines Guinea.	-
13.	INDUSTRIAL TECHNOLOGY: Power generation equipment, Transport vehicles, Industrial machinery related to paper, textiles and cement.	Nigeria, Romania, Venezuela, Yugoslavia.	-
14.	ENVIRONMENTAL PROTECTION Pollution control, Environmental Legislation and Education, Bioreserves, Ecology, etc.	Cuba, Egypt, Thailand, Venezuela, Zambia. Guinea.	-
15.	TRANSPORTATION SYSTEMS: Improvement of indigenous system, mass transportation systems, energy efficient transportation, railway system.	Yugoslavia, Zambia	-
16.	METEOROLOGY: Weather forecasting, Atmospheric Modelling, etc.	Cuba, Philippines	Cuba
17.	NATURAL RESOURCES SURVEY: Exploration and utilisation.	Philippines (Note: Number of countries had indicated interest in this area. However, the area was not specifically reflected in the Questionnaire. Countries may now indicate their interest).	

ANNEX IV

DIRECTORY OF TECHNOLOGICAL CAPABILITIES OF DEVELOPING COUNTRIES

SUGGESTED FORMAT FOR INFORMATION COLLECTION

1. Name of the Institution

2. Address in Full Acronym

3. Telephone Telex Cable

4. Year of Establishment

5. Type of Ownership

Public

Private

Joint

6. Name of the Head of the Institution:

7. Annual Budget (in US$ equivalent) 1979 1980 1981 1982

8. No. of Professional Staff Employed :

9. Major areas of Specilization covered by Professional Staff :

10. Affiliations with other Professional Bodies including Universities (Give names and locations)

i.

ii.

iii.

iv.

v.

vi.

vii.

viii.

ix.

x.

11. Links with Production for Commercial Enterprises/Consultancy and Engineering Organizations (Give names and locations)

i.

ii.

iii.

iv.

v.

vi.

vii.

viii.

ix.

x.

Main Areas or Sectors in which Research and Development is carried out

- ☐ Metallurgy (including Iron and Steel, Aluminium, Alloys etc. - please specify)
- ☐ Chemicals and Fertilisers
- ☐ Drugs and Pharmaceuticals
- ☐ Energy (including technology for improving fuel efficiency, renewable sources of energy, energy efficient transportation systems, etc.)
- ☐ Food Processing, Preservation and Storage
- ☐ Industrial Technology related to Cement, Textiles, etc.
- ☐ Exploration and Exploitation of Marine Resources (Please specify)
- ☐ Genetic Engineering and Biotechnology
- ☐ Microelectronics
- ☐ Instrumentation
- ☐ Improved Civil Construction Technology
- ☐ Others (please specify)

12. Significant Technologies developed by your institution since its inception

Title and brief description of Technology	Sector/area	Whether commercialised or not
1.		

Title and brief description of Technology	Sector/area	Whether commercialised or not
2.		
3.		
4.		
5.		
6.		

Significant Technologies developed by your institution since its inception

	Title and brief description of Technology	Sector/area	Whether commercialised or not
7.			
8.			
9.			
10.			

13. Important research activities in progress

Subject and brief description	Sector	No. of professionals working	Expected date of completion

18. Is your institution undertaking joint research and development activities with any institutions in other developing countries? If so, give details thereof:

Name and address of the sister institution	Brief description of project	Present status of research

14. Important research activities planned during next 5 years

Subject and brief description	Sector

15. List other activities undertaken by your institution apart from research, such as:

    Training

    Extension

    Setting up of Pilot Plants

    Consultancy

16. Important physical facilities including scientific and data processing equipment and library, pilot plants, etc. possessed by your institution.

17. Does your institution possess the capability to design plant and equipment and manufacture it on a pilot scale. If so, please give sector-wise details.

ANNEX V

ROSTER OF EXPERTS FROM DEVELOPING COUNTRIES

SUGGESTED FORMAT FOR COLLECTION OF INFORMATION

1. FAMILY NAME	First name	Maiden name, if any
2. Date of Birth	3. Place of birth	4. Nationality
5. Sex	6. Marital status	
7. Present address	8. Permanent address	Telephones Office: Residence:

9. Have you any dependants?

YES NO If answer is 'yes', please give following information

NAME	Date of Birth	Relationship	Occupation

10. Education: Give full details in chronological order (beginning from the latest) of your academic attainments, including specialized courses attended.

Dates attended	Name and location of Institution	Degrees/Certificates/ Diplomas obtained	Main areas of study

11. What is your main area of specialization or expertise?

11.A. PROFESSIONAL EXPERIENCES

From To

Employer

Title of Post

Nature of Duties

No. of professionals supervised

From To

Employer

Title of Post

Nature of Duties

No.of professionals supervised

From To

Employer

Title of Post

Nature of Duties

No. of professionals supervised

to

12. List of professional bodies/associations/which you belong

Name and location of the Body/Association	Year since when associated

13. List any signif'cant publications or papers you have authored

	Title of th ·ticle/book	Name of book/journal in which published	Date of publication
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

14. List any significant contributions to research and development that you may have made either individually or in collaboration with others. Give brief descriptions in each case.

15. Have any of your research findings been patented? If so, give details.

16. Have you been associated with commercialisation of any research findings? If so, give brief details.

17. Have you received any awards, prizes etc. for any significant contribution to research, development or innovation? If so, give details.

18. List any important consultancy assignments you may have undertaken in the past or are engaged in at present.

ANNEX VI

DIRECTORY OF CONSULTANCY AND ENGINEERING SERVICES IN DEVELOPING COUNTRIES

SUGGESTED FORMAT FOR COLLECTION OF INFORMATION

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1. Name of Organization Acronym

2. Address in Full

3. Telephone Telex Cable

4. Name of the Head of the Organization

5. Year of establishment

6. Ownership:

   Public

   Private

7. Annual Budget (in US$ equivalent) 1979 1980 1981

8. No. of Professional staff employed:

   Full Time basis :

   Part Time basis :

9. Major disciplines covered by professional staff

Discipline	No. of Professionals
Engineering	
Economics and Finance	
Marketing	
General Management	
Other (please specify)	

10. Membership of Professional bodies/associations

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11. Names of institutions/organizations with whom your organization maintains links or co-operative arrangements (including R+D Institutions, Financial and developmental institutions, chambers of commerce and industry, universities, other consultancy and engineering organizations in your country or abroad)

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

12. Type of services rendered (Tick wherever applicable)

i. Technology Services

- ☐ Surveys of natural resources
- ☐ Testing suitability of raw materials
- ☐ Advise in process improvement
- ☐ Plant layout
- ☐ design selection
- ☐ equipment selection
- ☐ Unpackaging technology components
- ☐ Technology adaptation and absorption

ii. Design and Engineering Services

- ☐ Project and plant design
- ☐ Preparation of tender documentation for purchase of equipment or civil engineering contracts
- ☐ Evaluation of bids
- ☐ Supervising erections of physical facilities
- ☐ Supervising start-up operations
- ☐ Others

iii. Management Services

- ☐ Advise in
- ☐ Production planning and control
- ☐ Inventory planning and control
- ☐ Material handling
- ☐ Product marketing / including storage and distribution
- ☐ Cost control
- ☐ Manpower planning, recruitment and training

13. Main areas/sectors of Specialization

- ☐ Power projects
- ☐ Fertiliser projects
- ☐ Chemical and pharmaceutical projects
- ☐ Civil construction projects
- ☐ Iron, Steel and other metallurgical projects
- ☐ Food processing and preservation
- ☐ Transport vehicles
- ☐ Projects concerning renewable sources of energy
- ☐ Petrochemical projects
- ☐ Public health projects
- ☐ Others

14. Important assignments already completed

Title and brief description	Sector	Total investment involve
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

(Please attach more sheets, if necessary)

15. Important assignments in hand

Title and brief description	Sector	Total investment involved
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

(Please attach more sheets, if necessary)

ANNEX VII

SUGGESTED FORMAT OF A TECHNOLOGICAL PROFILE

1. Background

This section should contain information about the importance and relevance of the particular industry or project in the over-all economic development of the developing countries, indicate the progress achieved so far and the perspectives for the future.

2. Alternative Technologies and their applications

This section should examine and evaluate the alternative technologies available in the developed as well as developing countries in regard to the particular project or industry, describe the alternative processes and indicate the sources from which the necessary technologies and processes could be obtained. It should also analyse the terms and conditions for acquisition of the required technologies and the problems involved in /their adaptation and absorption. The /requirement and sources of obtaining and training skilled manpower needed should also be analysed.

3. Plant and equipment

This section should contain information about different items of plant and equipment as well as raw material inputs required for the project together with their sources and costs. Core items which need a long lead time and peripheral items which can be easily obtained should be listed separately.

4. Utilities, Infrastructure and Technical Services

This section should contain information about the basic infrastructure and utilities that will be required for the project together with their financial implications. It should also indicate the consultancy and engineering organization which could provide, either wholly or partially, the preinvestment, project implementation and project management services.

5. Production Economics

This section should give information about over-all production economics of the project at different scales of production and capacity utilization.