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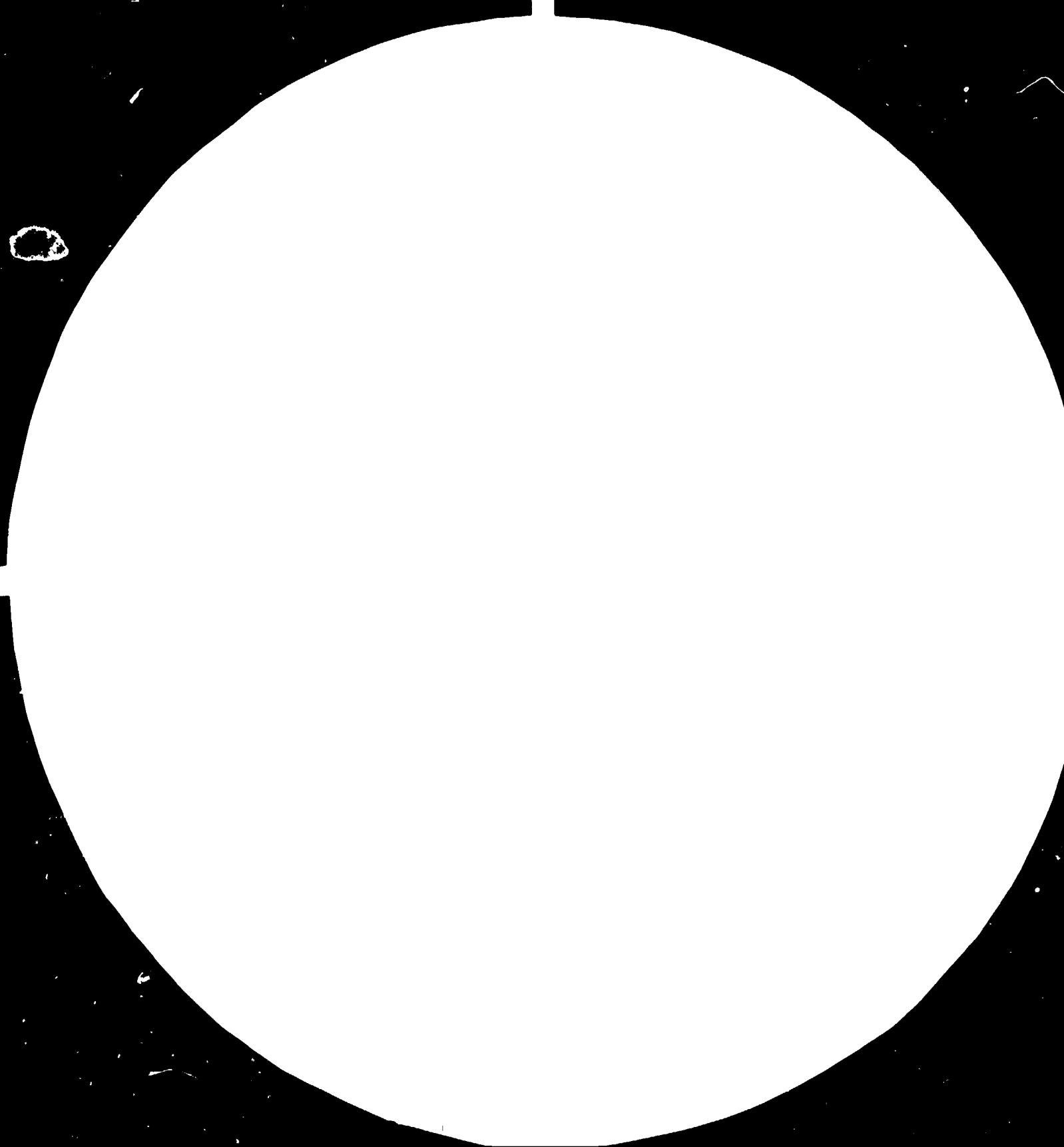
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

13523-E

Distr.
GENERAL
ID/CONF.5/5
10 January 1984
ENGLISH



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**FOURTH
GENERAL CONFERENCE
OF UNIDO**

Vienna, Austria, 2-18 August 1984

Item 5(b)

**STRENGTHENING OF
SCIENTIFIC AND TECHNOLOGICAL CAPACITIES
FOR INDUSTRIAL DEVELOPMENT
IN DEVELOPING COUNTRIES**

ISSUE PAPER

1891

Item 5(b) of the provisional agenda

INTERNATIONAL CO-OPERATION, RELEVANT NATIONAL ACTIONS
INCLUDING INDUSTRIAL POLICIES, AND UNIDO'S CONTRIBUTION
IN CRITICAL AREAS OF INDUSTRIAL DEVELOPMENT 1985-2000:

Strengthening of scientific and technological capacities
for industrial development in developing countries

Issue paper prepared by the UNIDO secretariat

INTRODUCTION

1. Developing countries have been, over the years, conscious of the critical role of science and technology in their industrialization. The progress they have made in strengthening their scientific and technological capabilities is considerable, granted that the systematic efforts of many developing countries in the field of technology date back, on average, not more than 15 years. At the same time, those countries face several constraints that will be aggravated in the 1980s on account of technological advances. However, those advances have also a certain potential for developing countries. To come to grips with this new situation, with tasks unfinished and new ones emerging, is the challenge to the developing countries in the field of industrial technology in the 1980s.

2. The issue of the strengthening of scientific and technological capacities for industrial development in developing countries is addressed in more detail in the background document (ID/CONF.5/6). Questions related to technological advances have also been dealt with in detail in the report (ID/WG.389/6) and papers of the International Forum on Technological Advances and Development (Forum), which served as one of the high-level meetings preparatory to this Conference. 1/ The primary focus in this paper is on technological capabilities, it being understood that corresponding scientific capabilities should also be strengthened.

I. MAJOR ISSUES

A. Progress achieved and constraints faced

3. What are the salient results of the efforts of developing countries in science and technology? Chapter I of the background paper attempts to answer this question. Most developing countries have paid attention to increasing their scientific and technological manpower and a substantial number to developing endogenous technology, though in both cases they are faced with several constraints. Many countries are still short of the requisite manpower and their efforts to create and apply endogenous technology have not been very successful. A relatively small number of countries have regulated the import of technology (in spite of the fact that most countries are primarily dependent on imported technology), and an even smaller number have formulated explicit technology policy and plans. Considerable ground has therefore to be covered by most developing countries towards achieving technological self-reliance.

4. The application and development of technology have led to a pattern of industrialization resulting in urban concentrations and geographical enclaves with little diffusion of industrial and technological development. The contribution of industrial technology to employment could be greater than it is if there were appropriate policies and programmes. Insufficient attention has been paid to the interaction of technology with the productive sectors and

thereby to the creation of a self-generating dynamism in the industrial structure. In general, the efforts of most developing countries have been ad hoc and fragmentary rather than within a total framework for national action. Clearly, there are unfinished tasks. What are the tasks that are emerging?

B. Impact of technological advances

5. During the 1980s and 1990s several technological advances, such as genetic engineering and biotechnology and micro-electronics, are expected to converge. Those advances are expected to alter the rate and pattern of industrial production, widen the technological gap between developed and developing countries and change life-styles. Something like 65 per cent of industrial production in developing countries could be affected by the technological advances. Apart from the impact on industry, there will be further impacts on other sectors and on development and society as a whole encompassing skills, employment, work, work environment, leisure, family and social life. The concept and content of technological capabilities are also undergoing changes; the new types needed may provide the key to productivity and international competitiveness in future. Chapter II of the background paper deals with this aspect, drawing upon the work of the UNIDO programme on technological advances in the last four years.

6. The developed countries have already initiated policies and programmes to develop and apply technological advances. What are the options for developing countries? They could either simply react to events and changes and keep rectifying their own positions in a changing world or assess the new technologies and develop their capabilities to use them purposefully for their own requirements. They may have to do both, and a timely and orderly response is of paramount importance. The technological advances should be approached as new opportunities for revitalizing the development process and improving the quality of life.

7. What are the features of technological advances that offer hope to developing countries? From the work done by the UNIDO secretariat covering a number of technological advances, 2/ two cases may be cited. Genetic engineering has imparted versatility and efficiency to biotechnology as a whole, which will enable the production of a wide variety of new or significantly improved products in a number of fields such as pharmaceuticals, energy production, agriculture and mining. It could provide new solutions to the basic problems of food, fodder, fuel and fertilizer. The technology would be energy saving, of low capital intensity, easy to apply and lend itself to decentralized applications. It could upgrade traditional technologies, make rural industrialization possible and improve the quality of life. By making a biomass-based strategy for industrialization possible, genetic engineering and biotechnology could open up a new pathway for industrialization in developing countries, in most of which the turnover of organic material is high.

8. As regards micro-electronics, the question is not whether it should be introduced in the developing countries but how. It is relevant to them in many respects, such as its far-reaching effects on the productivity of industries, its capacity for simplifying and imparting flexibility to manufacturing and industrial operations, its contribution to improvement of the quality and cost effectiveness of goods for the export market and its

value to strategic industries such as oil and power. Micro-electronics could also have a direct impact on the quality of life through applications that would improve, for example, public health and medical and educational levels in a country. At the same time the social implications of micro-electronics and its adverse impacts on employment in certain sectors cannot be overlooked. Developing countries, however, cannot delink themselves from this technology in an interdependent world economy; they will have to make complex decisions in regard to the manufacture of components and assemblies, applications, and lastly software, which is of crucial importance to them.

9. In regard to technological advances in general, there is a need for every developing country to take both short-term and long-term action. Short-term action should include forecasting and assessment of the socio-economic impact of technological advances, careful choice of technologies and equipment to be imported, and a strengthening of the negotiating capability for their acquisition. Such action is urgently needed so that irreversible distortion of the industrial and technological infrastructure is not created from the beginning. Long-term action should aim at strengthening technological capabilities and would require imaginative attempts to apply the technological advances to improve the standard of living and upgrade the general technological level of the population. Such action should be strategic, involving, wherever necessary, structural changes in the industrial and economic development of the country in the light of its development objectives.

10. What are the issues involved in integrating technological advances in the technological, industrial and social systems of the developing countries? Some relevant considerations are briefly discussed below.

11. Since conditions in developing countries vary and uniform prescriptions are not possible, countries may have to follow selective and differential approaches and each country may have to decide for itself the point of entry, degree of penetration, source of inputs, linkages, vehicles of implementation etc. However, in an interdependent world economy, all countries need to have technological awareness. Whatever the level of development, there is a need for a minimum level of competence to deal with emerging technologies within realistic time horizons and for establishing effective national groups for this purpose.

12. The social implications of the introduction of high technology have to be carefully considered by each country in its own socio-economic context. High technology options have to be placed within the range of available technology options from the traditional to the advanced. Developing countries may have to adopt and manage a technological pluralism optimal for the objectives, problems and limitations of each country. Such an approach would be in accord with the concept of appropriate technology as enunciated by the International Forum on Appropriate Industrial Technology organized by UNIDO in 1978. High technology should be used not only to start feasible industrial activities, but also to upgrade the general industrial and technological capability of the country including its traditional and decentralized activities.

C. Industrial technology for the 1980s

13. For the 1980s, a framework for national action is needed that will integrate the responses to technological advances with existing technology policies or efforts and at the same time make up the deficiencies of the latter. The building up of such a framework should be regarded as one of the major responsibilities of Governments in developing countries in the 1980s.

14. What are the possible elements for a framework of action? The UNIDO secretariat prepared such a framework as its contribution to the United Nations Conference on Science and Technology for Development held at Vienna, in August 1979 (A/CONF.81/BP/UNIDO). The same framework could be reoriented to take into account new technological advances. For drawing up such a framework a supporting mechanism may be necessary that could be, as a minimum, an interdisciplinary unit of 6-12 professionals close to a high policy-making level. Expertise has to be drawn from economists, scientists, technologists, social scientists, systems analysts, bankers, industrialists, management experts etc.

15. What are the important considerations in building up the framework? These include the upgrading of endogenous technologies; the integration of technology policies and actions with the industrial sectors; human resource development; the structuring and management of demand; and the rationalization and development of technological institutions having regard to their relevance, effectiveness and interaction. These and other considerations are discussed in chapter III of the background paper.

16. A new line of action for the developing countries would be to establish appropriate mechanisms individually or collectively to forecast, monitor and assess technological trends and their implications for economic and social development and to formulate, develop and implement policies to maximize the potential benefit of the new technologies and avoid their adverse consequences. Such an assessment should be an important input to industrial, technological and general development planning and the formulation of industrial, technological, commercial and fiscal policies, and in decision-making on industrial projects. Such information should also be used to see how far the new technologies could revitalize the development process in critical sectors.

17. The need for greater allocation of resources for science and technology in developing countries assumes greater relevance on account of the emerging technological advances. About a decade ago it was suggested that developing countries should allocate at least 1 per cent of their GNP to research and development. It is now proposed that they aim at devoting 1.5 per cent of their GNP for research and development by 1990, and reach a minimum level of 2 per cent by 2000.

D. International co-operation in the 1980s

18. International co-operation has a vital role to play in helping developing countries to correct the deficiencies already noticed and to harness new technologies for their unique problems. Chapter IV of the background paper discusses this issue, both in terms of enhancing ongoing co-operation and expanding its frontiers.

19. A review of the present trends in international co-operation shows that, at the enterprise level, costs and conditions of technology contracts and access to technology continue to be matters of concern to the recipients of technology. There is scope for considerable improvement in the attention to science and technology in official development assistance programmes and in intergovernmental project aid. Some major issues of international co-operation remain unresolved such as the financial contributions to the United Nations Financing System for Science and Technology for Development, the adoption of an International Code of Conduct on the Transfer of Technology and the revision of the Paris Convention for the protection of Industrial Property.

20. Several initiatives for co-operation between developing countries have been taken, such as the Technological Information Exchange System (TIES) and regional and subregional institutions and programmes, but considerable headway has to be made to achieve the goals set in the Caracas Declaration and Plan of Action.

21. The background paper (ID/CONF.5/6) proposes several measures for enhancing the existing co-operation between developed and developing countries both at Government and enterprise levels. In particular, attention is drawn to the incorporation of specific science and technology components in international aid programmes and improving the access to technology in the public domain (ibid., para.93).

22. Suggestions made in the background paper for advancing existing co-operation between developing countries include:

(a) Strengthening TIES and encouraging all developing countries that wish to do so, even if they do not have a technology registry, to become associate members of TIES so as to benefit from an exchange of information and experience other than those subject to reciprocal arrangements (para. 94);

(b) Encouraging the formation of consultancy consortia by developing country firms (para. 95);

(c) Undertaking a feasibility study for the establishment of an international network mechanism to promote technology exports (para. 97);

(d) Concluding preferential arrangements for technology transfer between developing countries in specific sectors, e.g. leather, food processing and oils and fats (para. 98).

E. New dimensions of international co-operation

23. The beneficial application of technological advances for development should be declared as a major goal for international co-operation in the 1980s.

24. The accelerated flows of, and access to, technological advances must be promoted at the enterprise level, in the public domain and between Governments. Co-operation between developed and developing countries in this respect is discussed in paragraph 101 of the background paper. In regard to enterprise level co-operation, the changing structure of the international technology market in the field of technological advances has to be noted. In this new configuration transnational companies could be expected to have control over not one group of technologies, but several related technologies such as in the energy, chemical, pharmaceutical and biotechnology fields. Developing countries will be the markets for several high technology products and processes, particularly in the case of biotechnology and solar and biomass energy. This gives the developing countries a countervailing power in regard to the terms of acquisition and the degree of local content.

25. The emergence of technological advances would, in a sense, lead to a new phase of co-operation between developing countries. In particular, those countries may have to consider together a collective strategy for the response to technological change. A forecasting and assessment network of developing countries is suggested in the background paper, with UNIDO serving as a clearing house for the network (para. 103).

26. New international mechanisms will also be necessary for different advanced technologies. As a result of the initiative of UNIDO 28 countries have already signed an agreement for setting up an International Centre for Genetic Engineering and Biotechnology. The background paper discusses briefly other initiatives arising out of the work of UNIDO in relation to an international centre for micro-processor applications and regional electronics centres or networks (para. 104), an international network of institutions engaged in research and development on industrial conversion of biomass (para. 106), a consultative group on solar energy research (para. 107) and an international mechanism for monitoring developments in the field of materials (para. 108). Work will have to be continued in these areas as well as in other technological areas of importance for the future such as sea-bed mining, on which work has already been initiated by UNIDO.

27. It is also proposed that a limited number of new advanced technologies to meet particular needs of a clear and urgent character of the human community be designated as "technologies for humanity". These technologies would be developed through commonly funded programmes and disseminated in the public domain. All countries able to contribute to developing these technologies should be encouraged to do so (para. 109).

28. It is proposed to establish an international roster of scientists and technologists in selected technological advances who are willing to assist developing countries through communications, training, field visits or a period of residence in those countries. Such a computerized roster, to be maintained by UNIDO, could be used by developing countries requiring specific expertise (para. 110).

29. Among the new dimensions of international co-operation, attention should be given to strengthening the technological capabilities of the African countries so as to be able to realize the objectives of the Industrial Development Decade for Africa.

II. NEW ROLE FOR UNIDO

30. UNIDO is already playing an important role in assisting developing countries in the development and transfer of industrial technology through technical assistance and promotional programmes and by the System of Consultations. However, the emergence of technological advances and the need for developing countries to respond to them places important additional responsibilities on UNIDO; the whole of UNIDO will have to be involved in this exercise. This is discussed in chapter V of the background paper. The technical assistance and other operational programmes of UNIDO will have to be substantially augmented to assist developing countries to keep pace with technological changes and create necessary groups, institutions and structures. The Consultations, even though they will be confined to selected industrial sectors, increasingly will have to take note of the impact of emerging technologies on those sectors.

31. A special responsibility lies with the UNIDO Technology Programme, in particular, in relation to its activities concerning technological advances. The Third General Conference of UNIDO recommended that institutional arrangements within the UNIDO secretariat should be strengthened with regard to technology, and adequate resources provided. ^{3/} This need has become more urgent in the light of the emergence of technological advances. Following the recommendations of the Forum, it is suggested that the UNIDO programme on technological advances (carried out by the Technology Programme) be expanded and diversified.

32. In addition to technical assistance and advisory services and the responsibilities assigned to UNIDO under Industrial Development Board resolution 47 (XI) and other mandates, the UNIDO secretariat should pay particular attention inter alia to:

(a) Stimulating and assisting developing countries to establish a policy framework for national action for the 1980s; assisting them in building up their technological capabilities in several fields of technological advances, including the setting up of national groups to monitor and assess technology trends and of core technical groups or institutions in selected technological advances; and carrying out studies and sensitization programmes to facilitate the above (para. 119 of the background paper);

(b) Strengthening negotiating capabilities of developing countries, in particular through a strengthened and expanded TIES, and monitoring world technology trends and the changing international technology market (para. 120);

(c) Promoting further technological co-operation between small and medium-sized enterprises of developing and developed countries in all areas, including the high technology areas (para. 121);

(d) Identifying and promoting the development and use of energy-related technologies and the equipment therefor (para. 122);

(e) Helping the developing countries, particularly through the Industrial and Technological Information Bank (INTIB), to handle and process technological information in an era of information explosion, and strengthening INTIB to enable it to fulfil in greater measure the objectives of its establishment, and its due role in a global system of scientific and technological information (para. 124);

(f) Providing special assistance to African countries for the development of technological capabilities within the framework of the Industrial Development Decade for Africa.

33. Regarding the promotion of international co-operation in general, the secretariat would have to take new initiatives, including promotion of regional and subregional action, in the following areas (para. 123):

(a) Promoting a forecasting and assessment network in developing countries;

(b) Promoting international centres or other mechanisms to strengthen the capabilities of developing countries in selected technological advances in accordance with their needs;

(c) Elaborating and implementing the concept of technologies for humanity;

(d) Developing and operating an international roster of high-level scientists and technologists;

(e) Organizing and making available to interested developing countries a travelling exhibition of applications of technological advances for development;

(f) Continuing the mobilization of interest and effort of policy-makers, the scientific and technological community and industry on a world-wide scale;

(g) Examining and pursuing new initiatives for technological co-operation between developing countries (e.g. consultancy consortia and an international network mechanism for technology exports).

34. The UNIDO secretariat will continue to co-operate closely with other international organizations in the work in the field of development and transfer of industrial technology.

Notes

1/ Expert group meetings to prepare for, and follow up, the Forum were held in Moscow (ID/WG.384/16) and Dubrovnik (ID/WG.401/7).

2/ The work of UNIDO in this field has covered, in varying degrees, genetic engineering and biotechnology; micro-electronics; information technology; telecommunications; materials; space-related technologies; sea-bed mining; energy from biomass and solar photovoltaic cells; and developments in lighter-than-air systems, machine tools and petrochemicals.

3/ New Delhi Declaration and Plan of Action, PI/72, Chapter III, "Industrial Technology".

