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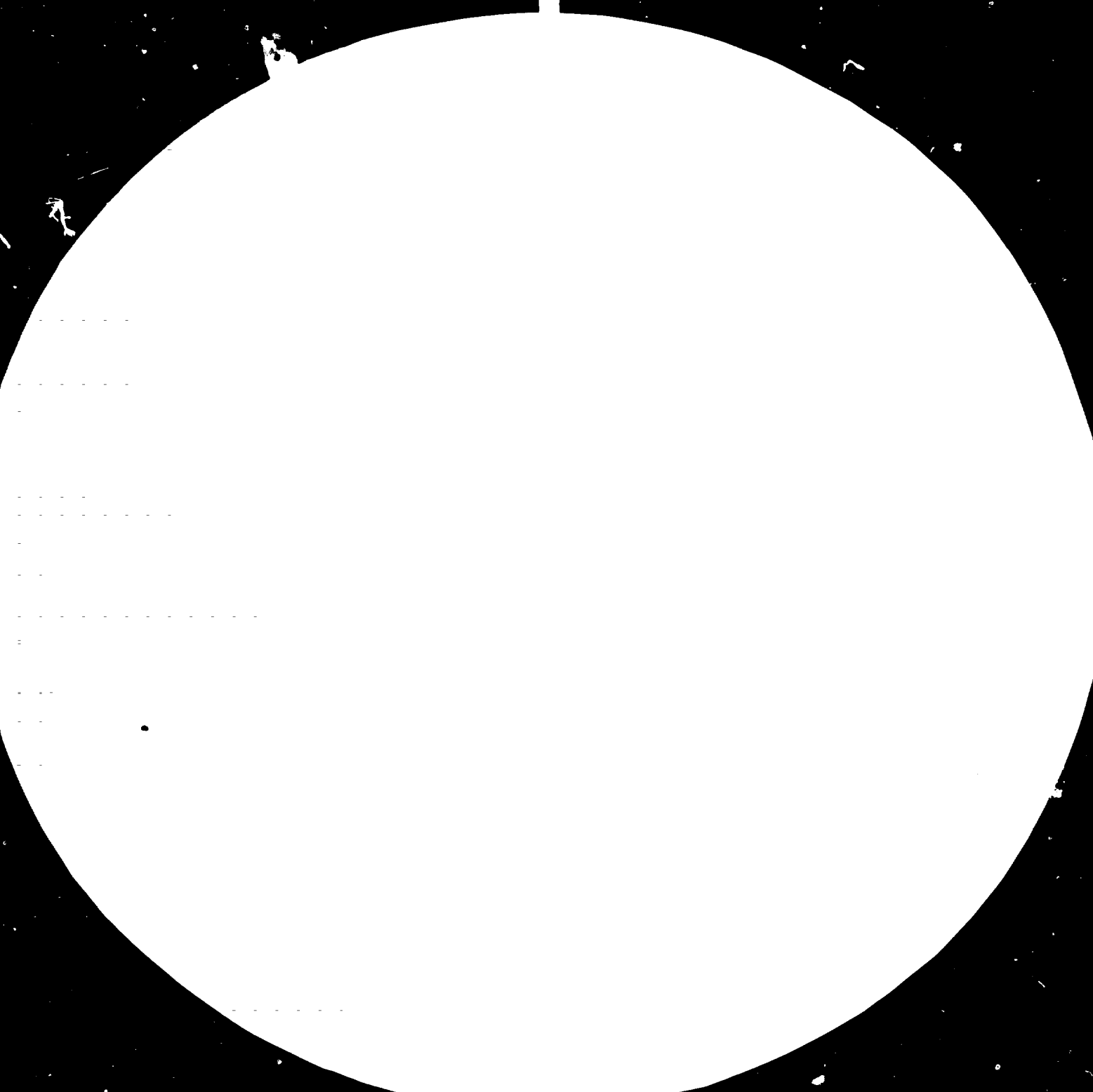
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## Industrial Development Board

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Agenda item 11

DEVELOPMENT AND TRANSFER OF TECHNOLOGY,  
INCLUDING THE INDUSTRIAL AND TECHNOLOGICAL  
INFORMATION BANK

Report by the Executive Director

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Summary

Reviews briefly the progress achieved in the field of development and transfer of technology and seeks to identify areas of action which will require greater attention in the coming years. The review is made in terms of the several dimensions of the problem such as selection, acquisition, adaptation, absorption and development of technology. The role of UNIDO and its assistance in this regard to the developing countries is examined and progress made by INTIB is analysed.

### Introduction

1. The Board, at its fifteenth session, after considering the report of the Executive Director on the development and transfer of technology (ID/B/252 and Add.1), commended the Executive Director on the progress made by the UNIDO Secretariat in that field and, in particular, on the initiatives taken in regard to advanced technology and appropriate technology. The Board drew attention to the need to implement in a pragmatic way the decisions it had taken in that respect at its fourteenth session and to strengthen existing institutional arrangements within the Secretariat in order to increase the technological capabilities of developing countries. It requested the Executive Director to present to it at its sixteenth session a comprehensive report on the work of the UNIDO Secretariat in that area and on the implementation of the decisions of the Board at its fourteenth session.<sup>1/</sup> It may be recalled that at its fourteenth session the Board had, inter alia, endorsed the broad programme directions proposed by the Secretariat in document ID/B/242 as a follow-up to the Third General Conference of UNIDO, stressing that high priority should be accorded to operational and promotional activities, and that institutional arrangements within the Secretariat should be strengthened.<sup>2/</sup>

2. At its fifteenth session, the Board also considered the report of the Executive Director on the Industrial and Technological Information Bank (INTIB) (ID/B/259), reaffirmed the important role of INTIB and approved its work programme. It decided to consider a comprehensive progress report on INTIB at its sixteenth session, while discussing the development and transfer of technology. The Board also called for factual information on the nature and extent of activities of INTIB.<sup>3/</sup>

3. The present report is submitted in compliance with the foregoing requests. Since the activities of the Technology Programme during 1981 are described in the Annual Report of the Executive Director, 1981,<sup>4/</sup> which also provides detailed information on the working of INTIB, the present report does not make a descriptive enumeration of activities. It reviews briefly what progress has been made and in which respects, and what tasks lie ahead for the developing countries and UNIDO in the field of development and transfer of technology, including industrial and technological information. In doing this, the programme directions endorsed by the Board at its fourteenth session<sup>2/</sup> are taken into account. The review is made against the overall background of the New Delhi Declaration and Plan of Action on Industrialization of Developing Countries and International Co-operation for their Development,<sup>5/</sup> adopted at the Third General Conference of UNIDO, and the Vienna Programme of Action on Science and Technology for Development,<sup>6/</sup> adopted by the United Nations Conference on Science and Technology for Development.

#### I. A REVIEW OF PROGRESS ACHIEVED

4. Industrial technology has a crucial role to play not only in promoting the industrialization of the developing countries, which has been considered to be the centre-piece of the development process, but also in providing the initial motive force for the building up of technological

<sup>1/</sup> A/35/16, paras.252, 255.

<sup>2/</sup> A/35/16, Vol.II, paras.70, 71, 73.

<sup>3/</sup> A/36/16, para.276.

<sup>4/</sup> ID/B/280, chap.IV, paras.56-96.

<sup>5/</sup> ID/CONF.4/22 and Corr.1, chap.II.

<sup>6/</sup> A/CONF.81/16, chap.VII.

capabilities over a wider front. Industrial technology capabilities are a major factor in the efforts of developing countries to attain the Lima Target and equally in the fulfilment of basic human needs and the process of technological transformation of developing countries. The question to ask is, while the objectives and the role of industrial technology capabilities have by and large been identified, whether the "mix" of efforts at the national and international levels has reached the critical mass and the strategy orientation that is needed.

5. Over the past decade and more, several significant issues have been raised and specific avenues of action opened up as a result of the perceptions and aspirations of developing countries in the field of technology in general and industrial technology in particular. To start with, attention was primarily focused on the transfer of technology from abroad, in which the major concern was the acquisition of technology and the costs and conditions thereof. At the same time, experience of the results of wrong choices of technology led to the call for appropriate technologies, which in turn led to an emphasis on the development of local technologies. This unfolding process also resulted in greater awareness that technological capabilities need to be strengthened, whether for the selection and acquisition of technology or for its development. At the same time, there was a constant emphasis on the creation of an institutional infrastructure for the development and transfer of technology and on the role of industrial and technological information, including the creation of a global technological information exchange system. Only recently has the role of technological policy begun to receive attention.

6. The United Nations Conference on Science and Technology for Development and the Third General Conference of UNIDO held in Vienna and New Delhi respectively were milestones in this process. The former represented a consolidation of the different perceptions into various programme areas, within which areas of concentration have since been identified by the Intergovernmental Committee on Science and Technology for Development. The Vienna Conference also led to a possible financing system for science and technology for development, thereby providing the means by which national and international technological effort could be supported. The New Delhi Declaration and Plan of Action emphasized the high priority to be accorded to industrial technology, and provided guidelines enabling the Secretariat to draw up the programme directions (see ID/B/242, para.15) endorsed by the Board at its fourteenth session.

7. Each of the above aspects of the approach to the development and transfer of industrial technology serves a specific purpose. In this context it is useful to review, on the basis of UNIDO experience, what the achievements in regard to each of those aspects have been, where the weaknesses lie, and what new elements have, in the meantime, emerged. The review has to be necessarily broad, keeping in mind the differences in conditions and in the efforts undertaken in this field in each developing country. The review is conveniently made by observing the transfer and development of technology as a process consisting of the stages of selection, acquisition, adaptation and development of technology and its absorption.

#### Selection of technology

8. In addition to generating projects, the co-operative programme of action on appropriate industrial technology<sup>1/</sup> has drawn the attention of developing countries to the choice of technology as an imperative and the availability of technological options in several industrial sectors.<sup>8/</sup>

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<sup>1/</sup> See the report on the "Co-operative programme of action on appropriate industrial technology" (ID/B/188), submitted to the Board at its eleventh session.

<sup>8/</sup> See Monographs on Appropriate Technology No.2-13 (ID/232/2-13).

It has also highlighted the need for an appropriate technology "mix" for each country, which should be derived from the industrial development strategy and eventually from the development objectives of the country. The co-operative programme also draws attention to the need to formulate suitable technology policies.<sup>9/</sup> A new factor that has more recently been recognized is that the choice of technology, viewed in a dynamic context, requires an awareness of future technological trends and it is this need which provides the rationale for the programme on technological advances initiated by UNIDO.

9. The scope for the selection of technology is, however, circumscribed by such factors as foreign investment and credit facilities from suppliers of equipment. The chain of events leading to a proper selection of technology comprises the availability of specific information and its evaluation and use by those involved in the selection process. Broader factors continue to be important, such as industrial policies in favour of large or small units and import policies. In these circumstances, international efforts must, by and large, be focused on highlighting the need for technology selection once the availability of alternatives has been determined and providing information and methodologies for processing or evaluating it.

10. The vast and growing mass of information now available makes it all the more necessary for developing countries to strengthen their capability to acquire and process information and apply it to the specific requirements of development. At the national level, at least 95 developing countries have established information systems and services, involving 432 institutions.<sup>10/</sup> Most information institutions seem to emphasize scientific and technological information of a documentary nature rather than the supply of problem-specific and processed information.

11. It is being increasingly realized, however, that the emphasis should be on the development of information systems and services responding in a direct and practical manner to development needs in various sectors and not on the storage and flow of information as a general infrastructure and as an end in itself. Apart from general bibliographical information, specific practical information is needed for the selection and acquisition of technology, for example sources of supply of technology and equipment, surveys and state-of-the-art publications, market reports, research reports, technological reports and new technologies produced by industrial or research institutions and commercialized by industry. Information has also to be linked to decision-making, which emphasizes the need for appropriate links between information units and the points of decision-making. These weaknesses underline the need for developing countries to review their information structures, or establish new ones, and to align the goals of those structures with those of industrial and technological policies.

#### Acquisition of technology

12. From the beginning, the main concern in the acquisition of technology has been to avoid excessive costs and restrictive conditions in the terms of technology contracts.<sup>11/</sup> This has led to an emphasis on the strengthening of negotiating capacities in developing countries. Measures for the regulation of imported technology were a logical sequel, and have been adopted by several countries, particularly the more advanced developing countries. These countries are now

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<sup>9/</sup> Conceptual and Policy Framework for Appropriate Industrial Technology, Monograph on Appropriate Technology No.1 (ID/232/1 and Corr.1)

<sup>10/</sup> "Directory of industrial information services and systems in developing countries" (UNIDO/IS.205), February 1981.

<sup>11/</sup> General issues relating to the acquisition of technology have led to the negotiation of codes of conduct for the transfer of technology.



exchanging information and co-operating among themselves under the aegis of the UNIDO Technological Information Exchange System (TIES) programme, which at present comprises some 28 participant and observer countries. The point to note, however, is that a large number of countries have yet to adopt any regulatory measures, and even the countries that have done so, do not all monitor imports of equipment constituting a transfer of embodied technology, or assess the extent of absorption to provide a basis for technological development. The need to strengthen the negotiating capacities of developing countries<sup>12/</sup> with respect either to the entrepreneur alone or to both the entrepreneur and the Government, has, however, been clearly recognized. To meet this need, manuals on the negotiation of technology contracts have been published,<sup>13/</sup> and similar guidelines for the negotiation of joint ventures are in preparation; training courses in negotiation are also being conducted and technological advisory services are being provided at the time of negotiation of technology contracts.

13. Experience gained from the TIES system has shown that regulatory institutions have helped to limit the size of payments for the transfer of technology and obviate restrictive clauses in technology contracts. The monitoring and follow-up of imported technology, however, are still not the strong point of all the regulatory agencies. The regulation of imported technology appears to be viewed as an operation by itself and not as part of a larger effort to absorb and further adapt or develop imported technology in the context of long-term industrial plans for specific sectors. Viewed in this larger perspective, all developing countries may find it useful to watch the inflow of technologies and their impact, though the need for and extent of regulation may vary according to prevailing conditions and policies in the country concerned.

14. UNIDO has also brought together representatives of technology transfer registries and the Licensing Executives Society (LES International) to provide them with an opportunity to exchange views and clarify attitudes. In addition, the System of Consultations provides a broad forum in which issues relating to the transfer of technology arising between developed and developing countries can find expression, leading to the formulation of model contracts, check-lists etc. based on recommendations made by Consultations in individual sectors.

#### Adaptation and development of technology

15. The need to adapt and develop local technologies has largely found expression in the creation of institutional infrastructures. A number of different types of technological institutions have been built in developing countries,<sup>14/</sup> for example single-purpose and multi-purpose research institutions, and standardization institutions; more recently, some technology transfer centres have been established at the national and regional levels.<sup>15/</sup> These institutions are engaged in the task of developing technologies locally and upgrading traditional technologies. The emphasis on local creativity, particularly for rural industrialization and development, has led to the creation of over 200 appropriate technology centres or units, which with some exceptions, are operated by voluntary agencies; they tend to be small, lack government support and are away from the mainstream of industrial activities.

16. The extent to which technologies have been developed and used commercially by the developing countries is still limited, however, as may be seen from the UNIDO compilations of technologies of developing countries and the studies initiated by UNIDO on technology exports of selected developing countries.<sup>16/</sup> Some 400 technologies, largely concentrated in a small number of developing

<sup>12/</sup> See ID/B/242, para.15(c).

<sup>13/</sup> Guidelines for Evaluation of Transfer of Technology Agreements, Development and Transfer of Technology Series No.12 (ID/233).

<sup>14/</sup> For a list of 42 developing countries and some 150 research institutes willing to co-operate among themselves, see "Directory of industrial and technological research institutes" (UNIDO/IS.275).

<sup>15/</sup> See ID/B/242, para.15(g), (h) and (i).

<sup>16/</sup> Ibid., para.15(f).

countries, are reported to have been developed in those countries and to be available for commercial use.<sup>17/</sup> The following major sectors are covered: mechanical engineering (99); construction industry (60); textile industry (52); energy (48); plants and plant products (46); food industry (37); and chemical industries (32). The number of technologies actually used commercially is very much smaller. Thus, the basic problem of developing local technologies still has to be grappled with in many developing countries.<sup>13/</sup> The problems of commercialization and the links with industry and the production system have not been given adequate attention. The commercialization of research findings requires a much larger degree of technological manpower and financial resources for such services as product and process development, pilot plants, plant design and installation, process adjustment, advice on manufacturing operations, quality control, and product and process improvement. With a few exceptions such skills and services are lacking in developing countries.

17. The commercialization of local technologies is not simply a matter of technical skill and more funding, however. The problems are ultimately related to domestic demand and preferences, and the creation of a milieu in which technological opportunities are seized for production purposes. A critical examination of successes and failures in commercialization in developing countries may throw more light on these matters.

#### Absorption of technology and technological capabilities

18. There is now a widespread awareness of the fact that local technological capabilities must be strengthened if the vicious circle of technological dependence is to be broken. Those capabilities are needed, whether for the selection and use of imported technologies or for the development of local ones. Considerable progress has been made in training the technological manpower needed for production operations contributing to the absorption of technology, although in several developing countries, particularly in Africa, a more substantial effort may be needed. There has also been a general awareness of the need to strengthen the system of education to help generate local industrial and technological manpower. Little attention has been paid, however, to the strengthening of capabilities for technological services. Such services range from macro-level industrial planning to micro-level project identification, feasibility studies, plant specifications, detailed engineering designs, civil construction and machinery installation, and the commissioning, start-up and operation of plants. The most significant gap, even in fairly industrialized developing countries, is in detailed engineering and design and in sectoral consultancy services provided by nationally owned units. This gap, with the consequent critical lack of infrastructure, makes the disaggregation of imported technology packages extremely difficult and creates an undue dependence on foreign design and engineering services. This dependence has a consequential impact on the pattern of investment for particular projects and on the requirements of capital goods and equipment, as well as on subsequent plant operations and management. In other developing countries, the gaps in consultancy services are even more marked and extend to almost the entire range of services indicated above. Nevertheless, there is now a considerable awareness of the need to disaggregate technology packages<sup>19/</sup> and to create local engineering and capital goods industries, which will contribute directly to the creation of technological capabilities.

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<sup>17/</sup> See Technologies from Developing Countries, Development and Transfer of Technology Series No.7 (Vol.I and II) (ID/208 and ID/246). Figures include technologies reported in Volume III (in preparation).

<sup>18/</sup> The constraints and problems have been well documented. See, for example, "Strengthening of technological capabilities of developing countries: a framework for national action" (A/CONF.81/BP/UNIDO), submitted by UNIDO to the United Nations Conference on Science and Technology for Development. See also "Joint UNDP/UNIDO evaluation of industrial research and service institutes" (ID/B/C.3/86 and Add.1 and 2).

<sup>19/</sup> See "A basic technological disaggregation model: (I) The petrochemical industry" (UNIDO/IS/283), originally prepared in Spanish by the secretariat of the Board of the Cartagena

19. A total framework for national action to strengthen local technological capabilities is still missing in many developing countries. This underlines the need for a technology policy. Nevertheless, explicit technology policies have only been developed in a handful of countries, although a small number have adopted policies relating to the acquisition or development of technology. The various problems still to be dealt with can be handled more effectively if there is an integrated technology policy and a framework for national action to strengthen local capabilities. That framework should be developed through conscious decisions on the technology "mix" and a clear assessment of the present status in regard to technological manpower, local technologies, sectoral requirements, the impact of existing policies, technological institutions etc.<sup>20/</sup> The emergence of new technologies has further emphasized the need for a technology policy, which itself has to be looked at in broader conceptual dimensions and in a dynamic context, taking into account the international trends in technology and trade.

20. The question of technological advances has at least three important dimensions in relation to developing countries. First, the advances in traditional and well-established industries in different sectors require to be monitored in relation to decisions on local manufacture, the potential for export, the implications for other industries etc. Thus it will be necessary to monitor long-term technological trends ranging from traditional sectors, such as sugar or oils and fats, to relatively newer industries, such as machine tools and petrochemicals, so that conscious policy decisions can be taken on the technological route that a given country wishes to follow with reference to its conditions and objectives.

21. Second, emerging technological advances, for example, in micro-electronics and bio-technology, are not only creating new industries but have wide implications for a number of other industries.<sup>21/</sup> The convergence of these technological advances itself produces an interaction, which again has implications for the pattern and rate of industrial production in developing countries. In other words, in planning for their industrial development and for achieving the Lima target, developing countries have to recognize that the present and coming decades are likely to witness substantial changes in production patterns owing to the expected interplay of the new technologies. These technologies have potential as well as limitations for developing countries and it should be part of the industrial and technological strategy of each developing country to see how it can tap the potential of the new technologies without being affected by their limitations.

22. The third dimension of technological advances relates to rising energy costs, which call for particular attention to be paid to energy-related industrial technologies, both for generating energy and for using it industrially.

23. Given these implications, the monitoring of technological advances at the national level in order to assist in policy making and decision making is a much-needed function, as demonstrated by the Mexican initiative to establish a permanent national team to monitor technological perspectives.

24. The foregoing review, brief and preliminary as it is, would seem to indicate that while national and international efforts already cover a wide spectrum, there are certain areas of action where efforts are lagging behind and others which are becoming more prominent. The conclusions to be drawn include the following:

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<sup>20/</sup> A/CONF.81/BP/UNIDO (see footnote 18).

<sup>21/</sup> On micro-electronics see, for example, "Implications of micro-electronics for developing countries: a preliminary overview of issues" (UNIDO/IS.246). On genetic engineering and bio-technology, see Impacts of Applied Genetics (Office of Technology Assessment, Washington D.C., 1981 (OTA-HR-132)) and Bio-Technology: Report of a Working Party (Advisory Council for

- (a) The basic thrust should continue to be the stimulation of action at the national level and international promotional action should therefore have a strong operational content;
- (b) The links between the emerging science and technology system in the developing countries and the productive sector continue to be weak, with the result that technology, whether imported or local, is still not being used as an effective tool for development;
- (c) While considerable progress has been made in building up an infrastructure for technology in terms of institutions, the nature and type of such institutions may need review; their links with production and the overall links amongst themselves continue to be weak; <sup>22/</sup>
- (d) Although technology is generated and used by human resources, the strengthening of technological capabilities is yet to be viewed within the overall context of human resource development. Current efforts notwithstanding, the development of technological services as design and consultancy services has lagged behind in many developing countries;
- (e) The harnessing of technology for rural industrialization and development has by and large remained more on a conceptual than on a practical action level;
- (f) In the light of the above, the technological problems of the least developed countries require more attention than hitherto, particularly the development and implementation of a basic national programme in technology by each least developed country; <sup>23/</sup> it follows that industrial technology activities in Africa should be considerably increased;
- (g) The provision of industrial and technological information should be predominantly goal-oriented;
- (h) The need to formulate technology policies, and in particular to establish a framework for national action, <sup>24/</sup> is paramount and greater progress is required in this field;
- (i) In addition to these considerations, which are essentially based on past activities and concerns arising therefrom, a major new dimension has emerged from converging technological advances, which have important implications for the rate and pattern of industrial production between now and the year 2000 and beyond.

25. The foregoing considerations need to be taken into account in the further orientation of UNIDO programmes.

## II. THE ROLE OF UNIDO

26. The contribution that UNIDO could make to the technological development of developing countries stems from the fact that no branch of economic activity influences or is influenced by technology so much as industry. Activities in industrial technology may, therefore, continue to provide an important motive force for technological development.

27. UNIDO has a unique role to play in assisting developing countries in this respect. It combines a promotional technology programme with substantial technical co-operation activities and a field presence together with a continuing System of Consultations, where technology transfer and development in the industrial sectors concerned receive particular attention from both developed and developing countries. In addition, in consonance with the objective of the

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<sup>22/</sup> The basic goal should be not so much to create institutions as to ensure that needed functions and services are performed. For a diagnostic matrix of institutional gaps and deficiencies, see "Industrial technology in Africa - a preliminary view: report and documents of the Joint OAU/UNIDO Symposium, Karthoum, November 1980" (UNIDO/IS.222), part II, chap. IV, table 2, pp.119-120.

<sup>23/</sup> As recommended, in fact, for all African countries by the Joint OAU/UNIDO Symposium (see footnote 22 above).

<sup>24/</sup> A/CONF.81/BP/UNIDO (see footnote 18).

Vienna Programme of Action on Science and Technology for Development, namely to apply science and technology to development, activities in the field of technology are carried out by UNIDO in juxtaposition with such activities as feasibility studies, investment promotion and the establishment of factories, which are other links in the chain of activities leading to the application of industrial technology for development. These factors have led to a programme and goal-oriented approach.

28. It is important to bear in mind that UNIDO technical co-operation activities have had as an integral and substantial component the development and transfer of industrial technology.<sup>25/</sup> Considering that the value of UNIDO technical co-operation activities is now \$88.5 million or more, the involvement at the national level is substantial. A few examples of major technology-oriented projects implemented by the Division of Industrial Operations will illustrate the position:<sup>26/</sup> a demonstration plant for sponge iron in India; strengthening of the technological capabilities of the Jamaica Bauxite Institute; metallurgical technology centres; capital goods projects; projects in the fields of computer-aided design and computer-aided manufacture; standardization in the field of iron and steel in Brazil; quality control in Turkey; assistance to technology transfer registries in Egypt and the Philippines; and assistance to industrial research institutes in some 15 countries (in 1981), including a large-scale project for the National Council on Science and Technology (CONACYT) of Mexico. As part of the co-operative programme of action on appropriate industrial technology (see ID/B/188), activities in progress include the development of technologies for using the jojoba plant and Balanites aegyptiaca; technology for the production of coconut cream; integrated cassava-processing technology; castor-detoxification technology; plastics in agriculture; and small-scale semi-automatic production of glass containers.

29. UNIDO is also responsible for implementing eight projects approved by the United Nations Interim Fund for Science and Technology for Development in 1981 with a total value of over \$6 million. These projects include: research in metallurgical processes; development of silicon technology; techniques for the production of sucro-based chemicals and antibiotics; recycling of chemical waste; and research in carbon-fibre composite technology.

30. As the agency dedicated to industrialization, with a central co-ordinating role in the United Nations system in this respect, UNIDO has the primary responsibility for promoting industrialization and the development and transfer of industrial technology. In discharging this responsibility, it will continue to maintain contacts and co-ordination with other agencies concerned in the United Nations system, both on an intersecretariat basis and at a working level. Details of co-operation with other United Nations agencies and regional centres for technology transfer are furnished in the Annual Report of the Executive Director, 1981.<sup>27/</sup>

31. While UNIDO will continue to focus its promotional and operational activities on the various aspects of the transfer and development of technology, bearing in mind the recommendations of the Industrial Development Board at its fourteenth session, special attention is called for in relation to some of the points that have emerged from the brief review in the preceding chapter. Their relevance to UNIDO activities is discussed below. Since activities based on the review

<sup>25/</sup> See ID/B/242, para.15(e).

<sup>26/</sup> See Annual Report of the Executive Director, 1981 (ID/B/280, chap.V) and for previous years.

<sup>27/</sup> ID/B/280, chap.IV, paras.95-96.

have already been initiated in regard to operational activities and technological advances, those two subjects are discussed at some length, and a separate chapter is devoted to the Industrial and Technological Information Bank (INTIB).

#### A. Operational activities

32. In view of the continuing concern of UNIDO with stimulating and assisting action at the national level, operational activities assume particular importance. Such activities should include not only technical co-operation projects but also promotional activities of an innovative nature, with scope for flexibility in their implementation, to demonstrate new concepts and approaches or stimulate and generate national action.<sup>28/</sup> Projects of this type promoted by the Technology Programme include technological prospects in Mexico, biological conversion of cellulose to ethanol in the Philippines, gasification of agricultural waste through pyrolysis in small-scale pilot plants in Africa, and co-operation between developing countries (Brazil and Kenya) in the design of small-scale fermentation plants. Activities of this type should have, as essential components, elements of technical co-operation among developing countries, dissemination of information and action-oriented studies and evaluations. The harnessing of technologies for rural industrialization and rural energy systems is yet another area where concepts are best promoted through a combination of studies and promotion in the field.

33. Some of the weaknesses that have emerged from the review made earlier relate to the commercialization of local technologies, the promotion of technological services and the effectiveness of institutional infrastructure. Action in these respects ultimately rests with enterprises, institutions and Governments of developing countries and the results of action are a function of many variables. Preliminary studies in these areas will be carried out to test what kind of promotional and operational programmes may be most effective in assisting developing countries.

34. The question of assisting least developed countries in formulating and adopting a basic national programme of action in the field of industrial technology corresponds to the recommendation made by the Khartoum symposium.<sup>29/</sup> In the review of its recommendations due this year, special attention will be paid to monitoring this aspect, keeping in view the overall context of the Industrial Development Decade for Africa. It is intended that operational programmes will be formulated for the least developed countries, particular attention being paid to tailoring these programmes to the requirements and conditions of each country, with the object of creating a basic technological infrastructure, building up the capacities of local technical personnel, promoting the development of scaled-down technologies and applying technologies designed to use local resources.

#### B. Technological advances

35. Efforts will be intensified to assist developing countries in adopting technology policies and a total framework for national action. In assisting in the development of such a framework, external expertise will associate local counterparts. The new dimensions added to UNIDO efforts in this regard will be the modalities for incorporating into policy-making the cognition of dynamic technological trends and their implications.

<sup>28/</sup> See ID/B/242, para.15(i), (j), (k) and (o).

<sup>29/</sup> See footnote 22.

36. Considerable interest has been evinced in the UNIDO programme of technological advances during its second year of operation. The programme will continue to proceed in three inter-related ways. First, technological trends in selected sectors of industry will be studied in relation to the potential for developing countries, the options available to those countries and the manner in which they should strengthen their technological capabilities in the respective sectors. These studies could also be an input to Consultations to discuss sectoral issues in a dynamic technological context. Secondly, the energy-related industrial technologies that are emerging, particularly in the field of new and renewable sources of energy, will need continuous monitoring and assessment and eventual promotion. A recent instance of this type in which the Technology Programme was engaged, is the examination of the possibilities of establishing a pilot plant for solar-cell production in developing countries. Plans are under way for the preparation of a manual for decision-makers in developing countries on the options and implications with respect to the production of ethanol. Thirdly, work will be continued and intensified on technologies of an intersectoral nature. Work of this type has already been initiated in regard to micro-electronics, biotechnology and genetic engineering and the industrial aspects of sea-bed mining. Activities concerning micro-electronics have also led to others in the field of informatics and industrial development and also to the need to study technological trends in the telecommunication industry and in the production of solar photovoltaic cells. The implications for developing countries of advances in the production and use of materials and their substitutes also need to be studied.

37. The activities undertaken with regard to micro-electronics and genetic engineering and biotechnology have themselves resulted not only in considerable interest and awareness on the part of developing countries but also in a series of meaningful follow-up steps. The sensitization phase at the international level has been well covered by the meetings held on the two subjects, by the studies and papers connected with those meetings and by the issue of mimeographed quarterly bulletins to target audiences in developing countries on developments in micro-electronics and genetic engineering and biotechnology respectively.<sup>31/</sup> At the international level, follow-up action includes the development of regional activities through a Latin American regional meeting in micro-electronics, planned for June 1982; and contributions made at the request of the Organization of African Unity on the implications of new technologies for Africa in connection with the proposed First Congress of African Scientists. The UNIDO contribution will be particularly focused on new technologies in micro-electronics and genetic engineering and biotechnology. In addition, a proposal was prepared for the establishment of an international centre for genetic engineering and biotechnology; it has received widespread interest.<sup>32/</sup>

38. Efforts to stimulate national action have also yielded results. In India and Kuwait, exchanges of views on developments in genetic engineering and biotechnology were held with the scientific and technological community and representatives of industry and government in January 1982. Experts in micro-electronics, genetic engineering and biotechnology, machine tools and petrochemicals will visit Egypt in 1982, at the request of the Government, to exchange views with Egyptian counterparts on the implications for Egypt of the long-term technological trends in those sectors. Similar assistance is being provided to Mexico within the framework of the project on technological prospects.

<sup>30/</sup> See ID/B/242, para.15(1).

<sup>31/</sup> "Micro-electronics monitor"; "Genetic engineering and biotechnology monitor".

<sup>32/</sup> "The establishment of an International Centre for Genetic Engineering and Bio-technology (ICGER)" (UNIDO/IS.254).

39. UNIDO is also trying to formulate and promote action-oriented programmes at the national level. In the field of genetic engineering and biotechnology some half-a-dozen project proposals are being formulated in areas such as microbial recovery of oil residues; bio-degradation of cellulose; and manufacture of animal vaccines involving genetic engineering. In addition, a proposal for a network of activities in African countries to upgrade fermented foods is being drawn up. In the field of micro-electronics, projects for the selective application of micro-electronics to specific problems of developing countries are being elaborated. The aim will be to demonstrate in specific cases how the application of micro-electronics might increase productivity in selected industries, in public utilities such as energy and transport and in some of the traditional rural activities, for example, processing and storage of grains. With regard to software, the possibilities of co-operation between developed and developing countries in setting up software houses to use micro-electronics hardware are under examination. Studies are also being made of the relevance to developing countries of programmes of industrialized countries in the development and application of software.

40. Considering the substantial impact that both micro-electronics and genetic engineering and biotechnology are likely to have on the future pattern of industrial production, the activities being embarked on should only be construed as the beginning of a larger programme, which should extend progressively to the national level and to specific practical action. There are also other aspects of the technological advances to be considered from the point of view of developing countries, for example, what is likely to be the combined impact of micro-electronics and genetic engineering, together with advances in telecommunication and the information revolution; how enterprises in developing countries, which will ultimately be the agents in the introduction of these new technologies, will react to the advances; what they will do and what policy actions are necessary to limit the transitional problems involved and to promote the introduction of the new technologies, where appropriate.

41. In monitoring and assessing the impact of technological advances, the UNIDO Secretariat, which has been nominated to chair the Working Group of the ACC (Administrative Committee on Co-ordination) Task Force on Science and Technology for Development dealing with new scientific and technological developments, will have the benefit of interacting with other international agencies with respect to their activities in related fields.

### III. INDUSTRIAL AND TECHNOLOGICAL INFORMATION BANK

42. The provision of information for the selection of technology on a goal-oriented basis is the aim of the Industrial and Technological Information Bank (INTIB). A comprehensive account of the progress made by INTIB is provided in the Annual Report of the Executive Director, 1981.<sup>33/</sup> Briefly, INTIB's basic output is processed information for technology selection, provided in two ways. On the one hand, information on alternative technologies is provided through active dissemination by means of publications (for example on fertilizers and iron and steel processes), profiles and information packages. On the other hand, information is provided in response to inquiries concerning the selection of technology and related matters. The provision of



information entails active contacts with diverse types of users and the ascertainment of their information needs, and equally active contacts with different sources of information, including data bases and a network of correspondents. In addition to these outputs, information on UNIDO-generated documentation is abstracted, maintained and distributed through the Industrial Information System (INIIS) data base and also in the form of publications. Information collected by the several parts of UNIDO is maintained in the On-Line Information Key (LINK) data base, to be used for specific ad hoc purposes. Other important activities include the publication of guides to information sources and information on technologies from developing countries. Basically, all these activities could be subsumed under three categories, namely, sourcing, processing and dissemination of information.

43. As the INTIB mission to Latin American countries in 1981<sup>34/</sup> showed, the end-users in developing countries know INTIB particularly through its industrial inquiry source, and seek information not only on the selection of technology but also on several related aspects of industry and technology. The information requested also extends beyond the 20 sectors identified for INTIB. In addition to inquiries requiring processed information, requests for documentary information and for information packages prepared by UNIDO have grown markedly in recent years. The following figures for 1981 are relevant in this connection:

- (a) Total inquiries for which information was provided: 1,067;
- (b) Number of requests for information packages complied with: about 1,000;
- (c) Number of requests for documents: 10,471 for 66,777 documents;
- (d) Number of documents sent to targeted readers: 21,160.

44. Under (a) above, food processing, agro-industries, chemicals, construction and building materials, capital goods and non-conventional sources of energy were the major sectors; and industrial enterprises, information centres, United Nations agencies and organizations, including UNIDO field staff, government departments and research institutions were the major users. Among the major user countries were Colombia, India, Nigeria, Turkey and Upper Volta. In some of the developing countries a number of institutions are regular clients of INTIB.

45. The INTIB mission to Latin American countries also showed that clients look to INTIB for the kind of practical information that goes beyond conventional scientific and technological information of the documentation type and which lies in the hinterland between that type of information and commercial and proprietary information that only supplier enterprises can provide. It is in this hinterland, where there is a marked paucity of information services, that INTIB will be most effective and where its uniqueness lies. Several acknowledgements by client-inquirers have corroborated the problem-oriented nature of INTIB.

46. With regard to the preparation of profiles on technological alternatives, INTIB is required to cover 20 industrial sectors and its capacity to prepare profiles has been handicapped by the limited financial resources that have been made available to it, in spite of the Board's recommendations at the fifteenth session. This has prevented INTIB from carrying out its task at the pace required of it.

47. Certain activities are being undertaken to improve the effectiveness of INTIB. A meeting of representatives of selected industrial development financing institutions from developing countries was organized by UNIDO in Barbados in January 1982. As a result of the meeting, a pilot programme will be initiated by UNIDO for the exchange of information on technology selection among those institutions. An INTIB mission to the African region to identify information requirements in the long-term context of the Industrial Development Decade for Africa is also envisaged. Later

in 1982, a meeting is planned in order to establish an advisory group of INTIB users, drawn from a cross-section of developing countries and regions and of users such as government departments, industry, R+D institutes and development institutions. The establishment of such a group will enable INTIB to prepare its profiles and information packages more closely on the basis of demand; it will also generate more demand for the INTIB inquiry service, will promote contacts and exchanges of information among users and between users and INTIB sources and in the process will contribute to the creation of a global network for the exchange of technological information in the field of industry.

48. As the INTIB missions to South-East Asia in 1980<sup>35/</sup> and Latin America in 1981 have shown, the effectiveness of INTIB is ultimately dependent on the strength and effectiveness of user institutions in developing countries. INTIB will undertake the preparation of a manual for the establishment - or redesign - of industrial and technological information services of a problem-oriented nature in developing countries, stressing not so much the traditional scientific and documentary types of institutions as the ones that will meet the more direct needs of technology policy and technology transfer and development. The manual will seek to integrate the information element into industrial and technology policies in developing countries. A new approach to industrial and technological information services may be needed in many developing countries, viewing the attendant costs not as part of limited allocations for the science and technology infrastructure but rather as important components of the overall investment and production that problem-specific information helps to generate.

#### IV. CONCLUSION

49. With tasks unfinished and new challenges emerging, developing countries may have to reassess their approaches to the development and transfer of industrial technology. Following the preliminary examination initiated by the present report, it may be necessary to develop an approach to the whole question of industrial technology for the 1980s. This is required not only for action at the international level and by UNIDO, but also to redesign, as necessary, the framework for national action. The question may be usefully taken up by UNIDO at its fourth General Conference. The Secretariat will keep this in mind in the preparation of documentation for that Conference.

#### V. ACTION REQUIRED OF THE BOARD

50. The Industrial Development Board may wish to review the foregoing analysis and provide comments and guidance on the further development of activities in this area. The Board may also wish to reiterate its earlier decisions in regard to the strengthening of institutional arrangements for the development and transfer of technology and the allocation of adequate resources to INTIB.

