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# TECHNOLOGICAL ADVANCES AND DEVELOPMENT : THE ROLE OF UNIDO*

prepared by

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## SUMMARY

This paper analyses briefly the experience of UNIDO in the past six years of activities in the application of technological advances for development, in particular in relation to technology assessment and related functions. Part I describes briefly UNIDO's approach in this regard and Part II analyses some of the UNIDO activities which have particular relevance to alerting developing countries to technological developments. In Part III brief concluding remarks are made.

CONTENTS

## I. Approach to Technological Advances

The convergence of technological advances is creating new industries and affecting existing ones over a wide range of sectors. Microelectronics, information technology and new materials have a pervasive effect on many sectors while genetic engineering and biotechnology affect in particular food processing, chemical and pharmaceutical, waste recycling and energy industries. According to UNIDO estimates something like 65 per cent of the industrial production of the developing countries might be affected to a greater of lesser extent on account of technological advances. The way production is organized in several industrial sectors is also undergoing change. The impact on industry is to be considered as only the first order of impact, with consequences to follow for other economic sectors and society as a whole. In view of global interdependence developing countries cannot hope to delink themselves from technological change and, on the other hand, they have to respond to it. Such a response has often to be formulated in a context of uncertainty, since they cannot wait to take decisions till the impact of such changes works itself out and can be studied in depth. They may have to follow selective and differentiated policies depending on their objectives and levels of development.

Developing countries have to take both defensive and positive measures. Such measures have to be transsectoral in terms of overall policy measures and also aim at strengthening capabilities in selected fields of technological advances. The defensive measures are necessary since indiscriminate induction of technological advances can produce irreversible distortions in the economies of developing countries. At the same time positive measures are essential since, as the International Forum on Technological Advances and Development, organized by UNIDO in April 1983 in Tbilisi, emphasized[1/] that the challenge of the new technologies can be turned into an opportunity if they can be used for revitalizing the development process. The harnessing of technological advances for development is the real challenge before the international community.

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1/ See Report of the International Forum on Technological Advances and Development, ID/WG.389/6

There can, of course, be no uniform prescription for all countries and in particular for all developing countries. The International Forum suggested the following approach.[2/] 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. A country should, however, strive to reach a high level of competence in the longer term while in the short run it may aim to obtain a given level of competence, in particular technologies and productive sectors. The entry points for countries at different levels of development could be:

Minimum level: awareness, continuous monitoring, critical and relevant technological intelligence; identification of needs and relevance, ability to assess, select, negotiate and utilise technology; autonomous decision-making.

Medium level: the above and in addition ability to adapt or generate technology:

High level: all the above as well as capacity for commercialization, design, manufacture of equipment, and participation in competitive international markets.

The foregoing levels and elements should be viewed in a dynamic framework, with each country selecting its entry point and advancing its level.

In light of the aforementioned approach, UNIDO has adopted a range of measures to help developing countries at different levels of development, both in terms of transsectoral policy aspects and measures to help developing countries to strengthen their technological capabilities selectively. The activities involve national, regional and international levels and are directed towards sensitization, assistance

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2/ ibid, pp. 25-26

in policy formulation and technical assistance and promotional measures to strengthen technological capabilities. The question of sensitization is viewed in a larger context both in relation to actions in the field of technology and to the linkage with the productive sectors and integration in the existing infrastructure.

A schematic presentation of the range of UNIDO activities in regard to technological advances is contained in the Table 1.3/

## II. Activities Relating to Sensitization and Alerting

The first step in sensitizing and alerting developing countries is to increase their current awareness. This is done by UNIDO through "Monitors" in the fields of microelectronics, genetic engineering and biotechnology, and materials which are issued quarterly and contain a wide range of information on the basis of which the reader could reach his own conclusions on the trends in technology. The Monitors are also accompanied from time to time by a systematic review of trends in any particular area. For example, the Microelectronics Monitor has carried supplements relating to flexible manufacturing systems and technology and market trends in the production and application of information technology and in Issue No.15 an article on the state-of-the-art of gallium arsenide. The Biotechnology Monitor has carried a supplement on developments in the field over the past two years and has also published a state-of-the-art review on biotechnology in food production and processing. The Materials Monitor is designed as a current awareness cum alert service in the sense that each issue deals with a specific type of material and incorporates a wide range of information and expert assessment in relation to that material. Thus developments in high-strength low alloy steel, high temperature ceramics, optical fibres, powder metallurgy and plastics have been covered. In the future issues of the monitors increasing emphasis will be given to assessments in given areas.

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3/ For a description of UNIDO activities in this field please see "The UNIDO Programme on Technological Advances", UNIDO/IS.411/Rev.1

Detailed assessments have also been carried out through expert studies and meetings. Typically, such studies review the state of the art and anticipated trends in R and D and production in a given area, examine the potentials and implications for developing countries including trade implications and socio-economic aspects and suggest the possible directions for strengthening technological capabilities. For example, in the field of microelectronics, such studies have covered the areas of software and its licensing, image processing, public purchasing, interrelation between microelectronics and telecommunications, trends relating to design of chips and a silicon foundry approach, computer-aided design and review of state of the art in selected countries. In the field of genetic engineering and biotechnology, where UNIDO has access to a high-level Panel of Scientific Advisers, a series of technological assessments are made as part of the process of preparing the work programme for the International Centre for Genetic Engineering and Biotechnology which has been promoted by UNIDO. They cover the area of agriculture, human and animal vaccines, food processing, bioinformatics etc. A workshop held at New Delhi in September 1985 reviewed the trends in genetic engineering research relating to agriculture and identified the possible lines on which research programmes may be organized in the International Centre. A similar workshop in Trieste on biotechnology and industrial commodities is planned for March 1986. Studies on the telecommunications industry have covered the general implications for developing countries as well as the specific implications for Latin America. Studies in other sectors include studies relating to seabed mining and an approach to technological disaggregation, marine industrial technology, marine biotechnology, optical fibres, composites, space-related technologies, lighter-than-air technologies and biomass and solar energy technologies. The changing international technology market structure in selected technologies has also been studied.

At the transsectoral level the emphasis has been to sensitize developing countries to the issues involved in integrating technological advances in the mainstream of industrial production. Thus a study on integration of industrial and technological policies has been made with special reference to Japan and the implications of a similar approach by developing countries. An expert group meeting has specifically considered the question of institutional and structural responses of developing countries to technological advances.

It has clearly been realized that actions at the national and regional levels are indispensable and international actions to sensitize and alert developing countries should be part of an integrated effort. Thus, for example, national policy workshops have been assisted with specific reference to new technologies in Malaysia as well as Trinidad and Tobago; in Kenya and Mexico (microelectronics); and India, Kuwait and Cuba (biotechnology). An expert report on the establishment of a technology monitoring system in microelectronics in Argentina was prepared and a National Workshop on Policies, Technological and Economic Trends in Informatics was held from 28 April to 2 May 1986, Buenos Aires, Argentina. Studies on the developments in numerically controlled machine tools and design of integrated circuits will shortly be published under the Technology Trends Series. In Mexico a project funded by UNFSSTD has been implemented to set up a national team to monitor technology perspectives. Under this project expert assignments were carried out in Mexico in the field of microelectronics, biotechnology and materials (optical fibres, ceramics and plastics) reviewing international developments and relating them to the Mexican context. As a result of this activity the Mexican Government has in its Industrial Plan incorporated further activities in relation to technological advances.

Two significant activities at the regional level in microelectronics have included specific provisions for sensitization and alerting. Following a UNIDO/ECLAC meeting on microelectronics in 1982 and subsequent expert missions a Regional Network for Latin America and the Caribbean (REMLAC) was established with eight countries participating in a UNIDO meeting in Caracas in June 1985. Among the activities foreseen is one relating to technology monitoring in the field of

microelectronics. A review of trends in regard to the multichip approach to design and fabrication of integrated circuits is also being carried out. Regional activities have also been implemented in the West Asian region and after a general survey of technology trends and the requirements of West Asian countries, a regional meeting on the specific question of silicon foundry and design centres was held in Algeria in January 1986 in co-operation with the Economic and Social Commission for Western Asia (ESCWA). For this purpose the state-of-the-art in this field has been reviewed in detail.

In regard to Africa, the UNIDO secretariat provided 18 experts from Africa and from developed countries for participation in the expert group meeting on the implications of new technologies, held at Mbabane, Swaziland, 22-26 October 1984. The papers presented by the experts and staff members have reviewed technological trends, particularly in microelectronics and biotechnology and their potentialities and implications for Africa with particular reference to the implications for the Programme for the Industrial Development Decade for Africa. UNIDO and other relevant international organizations were asked by the meeting to intensify their programmes of assistance to African countries and organizations in the fields of microelectronics as well as genetic engineering and biotechnology.

Special activities have been initiated by UNIDO to highlight applications of technological advances for development. In the field of microelectronics and information technology a Consultative Group on Information Technology (COGIT) has been constituted which brings together the experience of several organizations involved in the application of information technology for development. A meeting will be held in the autumn of 1986. In the field of biotechnology studies have been carried out relating to the protein-enrichment of gari, the fermented cassava food in Africa and also relating to a West African plant which is a protein sweetener. Under a concept originally titled "Technologies for Humanity", international co-operation projects to promote the application of modern technology to meet the needs of the rural poor have been initiated. Two expert meetings have been held, one on protein enrichment

of gari and the other on industrial manufacture of proven designs of improved woodburning stoves. The socio-economic aspects are taken into account in such studies as also the question of upgradation of traditional technologies.

## III. Concluding Remarks

In securing effective sensitization and alerting, several constraints at the national level must be faced, such as taking decisions in a context of uncertainty and inadequate information, the complexity and the dynamic nature of the issues discussed, the capability for assessment that must exist at the national level, the linkage to policy and decision-making and integration in the mainstream of production. A composite effort in terms of several types of interrelated actions has been undertaken by UNIDO in which sensitization and alerting developing countries is carried out as part of a wider range of activities which together constitute a programme on technological advances. Such activities not only link sensitization efforts to overall efforts in developing technological competence but also try to relate them to productive sectors (in particular to industry) and the process of industrial restructuring as a result of technical change. In view of the range and type of activities undertaken by UNIDO it is in a position to take a lead role in any international network to be created in alerting developing countries to technological developments, particularly in microelectronics, genetic engineering and biotechnology and new materials.

The Fourth General Conference of UNIDO (Vienna, 1984) has stressed the function of sensitization and alerting of developing countries. In its Resolution 2, it recommended that "developing countries should establish appropriate means, individually or collectively to forecast, monitor and assess technological trends and their implications for social and economic development and that they should formulate and implement policies to maximize the potential benefits of the new technologies and avoid their adverse consequences". It also recommended that UNIDO should

continue to monitor world technology trends and the changing international technology market and assist developing countries in setting up national groups to monitor and assess technological advances and technical groups or institutions in selected technological advances.

Several other activities of UNIDO will reinforce the UNIDO effort in sensitization and alerting developing countries, such as the international roster established by UNIDO of eminent scientists and technologists in new technologies (about 350) who provide a valuable reservoir of expertise for consultation and assessment; the setting up of computer conferencing facilities with the Panel of Scientific Advisers for the ICGEB in the near future; preparation of an annual survey of global technology trends; and maintenance of sectoral dossiers by UNIDO's Industrial and Technological Information Bank on impacts of technological advances on industrial sectors.

TABLE 1

UNIDO Activities Related to Technological Advances

(illustrative)

| Activity | International | Regional | National |
|---|---|---|---|
| **Microelectronics and information technology** | | | |
| Sensitization and alerting | - Microelectronics Monitor<br>- Studies and reviews relating to software and licensing, i.c. design and silicon foundry, CAD, microprocessor applications, telecommunications information policies state-of-the art in selected countries, public purchase, applications in sugar and meat processing, biomedical applications, pattern recognition | Implications for Africa, Latin America, West Asia | National-level workshops (Mexico, Kenya, Trinidad and Tobago) |
| Expert workshops | - Expert Workshop (1981)<br>- Consultative Group on Information Technology<br>- Working Group on expert meeting on technological advances and development (1982) | Meetings in Latin America (1982,85)<br>Africa (1983) and Arab region (1983, 1984,1986) | Expert meeting (1981) |
| Technical assistance and promotional activities | - International Roster of Scientists and Technologists<br>- CORIS | Establishment of Regional Network for Microelectronics for Latin America and the Caribbean<br>Microelectronics Programme for the ESCWA region | Technology Monitoring in Mexico, Argentina.<br>Technical assistance in electronics, instrumentation, CAD, CAM, automation, NC machine tools, microprocessor |

| Activity | International | Regional | National |
|---|---|---|---|
| Genetic Engineering and Biotechnology | | | |
| Sensitization and alerting | - Genetic Engineering and Biotechnology Monitor<br>- Studies and reviews relating to impact on development, foodprocessing and pharmaceuticals, conversion of cellulose, mineral leaching etc. | | National-level workshops (Kuwait, Trinidad and Tobago, India, Cuba) |
| Expert workshops | On animal vaccines, lactic acid fermentation and agriculture (in relation to ICGEB programme) | Meeting in Africa (1983)<br>Participation in meeting for Arab region | |
| Technical Assistance and promotional activities | Establishment of International Centre for Genetic Engineering and Biotechnology<br>International Roster of Scientists and Technologists | Regional network in Latin America and proposed network for Africa.<br>Project for establishment of a regional centre in Latin America. | Advisory service to Brazil on national programmes.<br>Project on enzymatic conversion of cellulose in the Philippines. |

| Activity | International | Regional | National |
|---|---|---|---|
| **New Materials** | | | |
| Sensitization and alerting | - Materials Monitor (high strength low alloy steel, high temperature ceramics, optical fibres, powder metallurgy, plastics)<br>- Study on composites | - | - |
| Expert meetings | Expert meeting on technological advances and development (working group report)<br>International meeting on carbon fibres | - | - Examination of development of optical fibres and ceramics in Mexico. |
| Technical assistance and promotional activities | | | - Several technical assistance projects including a project for development of silicon in Pakistan.<br>- Carbon fibre project in Brazil. |

| Activity | International | Regional | National |
|---|---|---|---|
| **Solar and biomass technologies** | | | |
| Sensitization and alerting | Directory of institutions on industrial conversion of biomass; directory of solar energy research | | |
| Expert meetings | Working group of expert meeting on technological advances and development | | |
| Technical assistance and promotional measures | Consultative Group on Solar Energy Research (proposed) | | Several national projects |
| **Space-related technologies** | | | |
| Sensitization and alerting | Study on selected space-related technologies and their potential for developing countries | | |
| Expert meetings | Expert group meeting on Lighter-than-Air Technologies | | |
| **Telecommunications** | | | |
| Sensitization and alerting | Study on developments in telecommunications industry and implications for developing countries | Study on Telecommunications industries in Latin America | Study on telecommunications industry in Brazil |

| Activity | International | Regional | National |
|---|---|---|---|
| **Machine tools** | | | |
| Sensitization and alerting | Study on Perspectives of machine tool industry | | |
| Technical Assistance and Promotional Activities | | | Several national projects |
| **Petrochemicals** | | | |
| Sensitization and alerting | Study on Perspectives of petrochemicals technology | | |
| Technical Assistance and Promotional Activities | Consultation meetings<br>Working group of expert meeting on technological advances and development. | | National projects |
| **Marine industrial technology** | | | |
| Sensitization and alerting | Studies on seabed mining and technological advances; marine industrial technology; marine biotechnology | | |

| Activity | International | Regional | National |
|---|---|---|---|
| **General** | | | |
| Sensitization and alerting | Studies, e.g. on integration of industrial and technology policy, role of technology in international industrial restructuring. Proposed global technology survey. | | National workshops (e.g. Trinidad and Tobago, Malaysia) |
| Expert meetings | Expert group on technological advances and development (1982); International Forum on Technological Advances and Development (1983); and Expert Group on institutional and structural response to technological change (1983). UNIDO IV. | Expert Group meeting in Africa (1983) | |
| Technical assistance and promotional activities | | | Project in Mexico on technology monitoring |

ANNEX I

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