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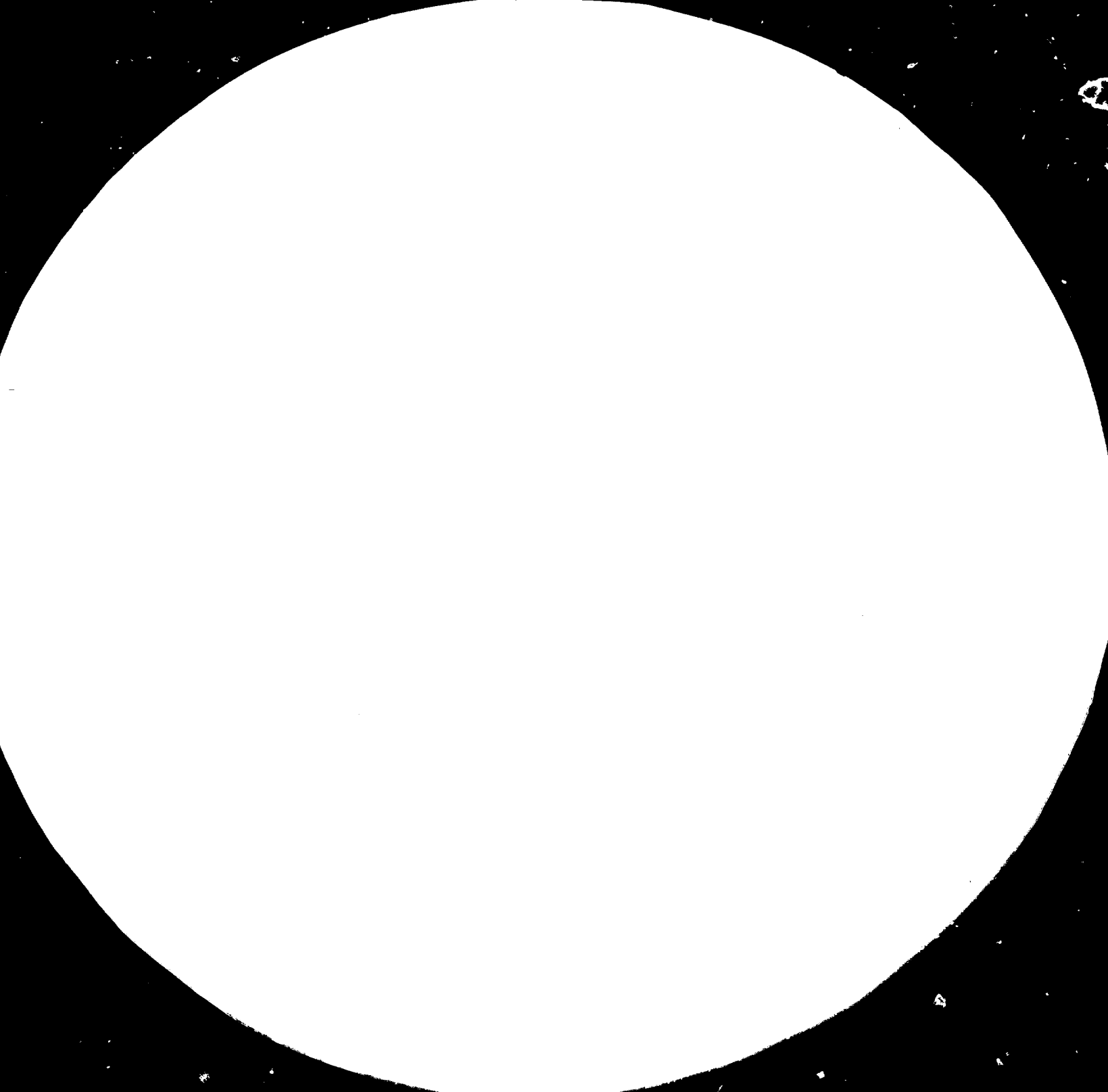

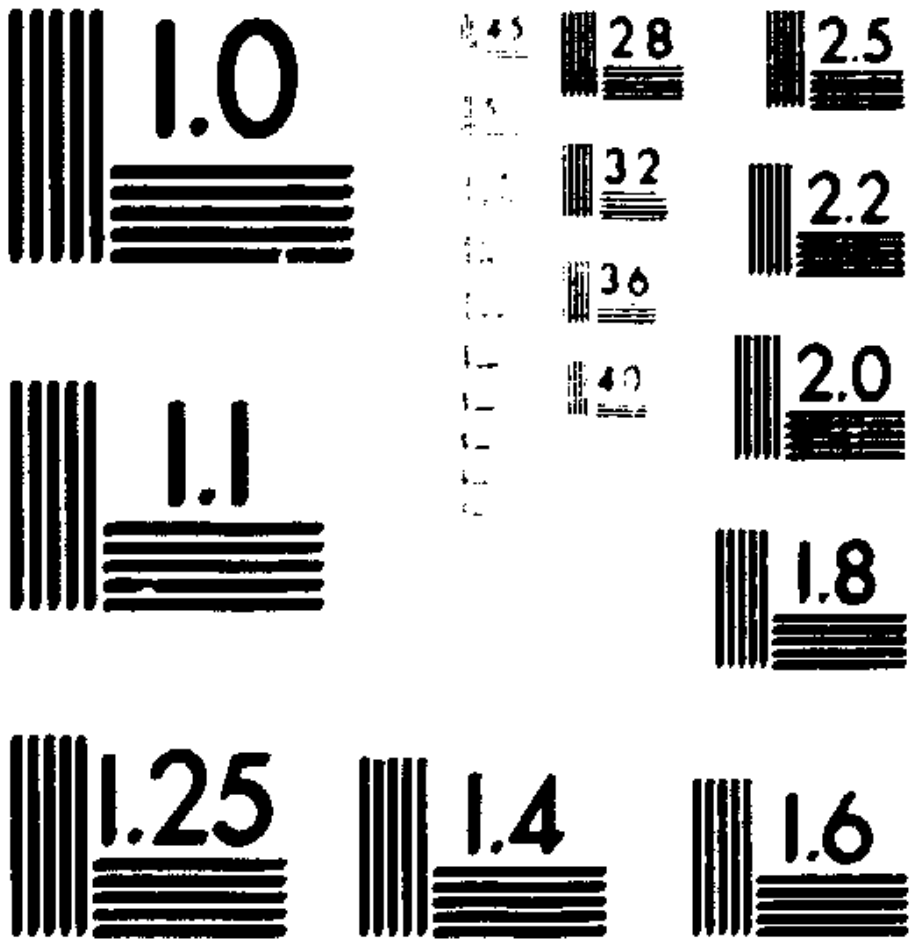

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THE UNIDO PROGRAMME ON MICROELECTRONICS : AN ANALYTICAL PERSPECTIVE*

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Contents

I. The Importance of Advanced Technologies to Development : Realization and a Strategy

1. Following the Third General Conference of UNIDO in 1980, a major new programme was established in the Technology Programme of UNIDO dealing with the potentials and implications of technological advances for developing countries. Those advances are not only creating new industries but have substantial implications for a number of other industries. The convergence of these technological advances itself produces an interaction, which in turn has implications for the pattern and rate of industrial production in developing countries. In other words, in planning 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 advanced 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.

2. The International Forum on Technological Advances and Development, held at Tbilisi, USSR, in April 1983, which provided inputs for the UNIDO documentation for UNIDO IV, in this respect brought up a concept of "technologies for humanity". The Forum recommended that a new form of international co-operation be considered, with the designation of a limited number of new advanced technologies in order to meet the particular needs of clear urgency to the human community. These technologies should be developed and disseminated in the public domain. They should be clearly and precisely defined, so that international efforts can be focussed on specific problems until appropriate solutions are found and effectively disseminated throughout the world, especially in developing countries. All nations able to contribute to the development of these technologies should be encouraged to do so. Commonly funded programmes for such technologies for humanity could make

it possible to disseminate the fruits of modern science and technology so as to improve the quality of human life at large. Such a move would reinforce the commonly held aspiration that the human being must be the centre of concern in technological development.

3. The idea behind the concept is that instead of engaging in occasional and unrelated skirmishes with the problem of applying technological advances for development, the international community should launch a broad frontal attack. This involves mobilization not only of financial resources but the will and commitment of a number of countries as also the dedication and participation of the international scientific and technological community. The concept which was presented to UNIDO IV was generally supported in regard to its objectives and there was agreement that appropriate technologies including advanced ones should be promoted and developed to meet particular needs of clear urgency to mankind.

4. The agenda of the Fourth General Conference of UNIDO (UNIDO IV) included, inter alia, the subject of strengthening the scientific and technological capabilities for industrial development in developing countries. When this item was discussed the UNIDO secretariat drew attention to the changing technological world scene and the consequent need for developing countries to rectify past deficiencies and come to grips with the new situation. As technological advances were expected to affect a wide range of industrial sectors, it was necessary for each country to reduce the adverse consequences of these advances to a minimum and maximise their benefits through a selective and differentiated policy adapted to their own requirements. In the ensuing discussion UNIDO's programme on microelectronics was commended and support was expressed for promoting the establishment of regional and international centres for selected advanced technologies as well as the networking of existing institutions in the respective regions. Developing countries may identify gaps in existing arrangements with a view to considering the setting up of national, regional and interregional centres as well as networking existing facilities, including research and development institutions.

5. The Conference recognized that the new technologies will have a wide-ranging impact on industrial development and endorsed the importance of strengthening scientific and technological capabilities for industrial development in developing countries; it urged UNIDO to assist developing countries in building their technological capabilities in different fields of technology including the setting up of national groups to monitor and assess technological trends and the changing international market and promote the building of core groups or institutions in selected technological advances. The present information explosion was also noted; in this connection UNIDO's Industrial and Technological Information Bank (INTIB) was requested to help developing countries in handling and processing technological information and also make its own information available to developing countries.

6. A major problem which has to be dealt with at essentially the national level is the integration of technological advances into the mainstream of production and the blending of emerging and traditional technologies. International action would be essential however in providing models for such integration as well as promoting, developing and demonstrating specific technologies, products and processes through which such blending may be achieved. The concept of appropriate technology acquires a new relevance and dimension in this context. It may also be useful to recall the experience of the numerous appropriate technology institutions operating at international, regional or national levels and draw lessons, positive or negative, from their experience. The positive aspect of such efforts has been the practical demonstration of the interest and commitment of scientists and technologists to apply modern science and technology for development; the negative lessons are that the efforts have been generally isolated instances outside the mainstream of production in the respective countries, that they could not be harmonized to introduce elements of synergy and that, in the absence of adequate financial resources, they did not reach a critical mass. Nonetheless, it is now opportune to think of stimulating and activating a variety of international institutions and professional associations, as well as the academia, to engage themselves in activities with a broad common aim and with full awareness and interaction in the task of applying technological advances for development.

II. Microelectronics Technology : Potentials and Needs

7. The technological advances in microelectronics have certain characteristics which make them appropriate for use in developing countries. Microelectronics has opened the door to a vast array of needed applications which can, apart from improving productivity over a wide front, help obviate the shortage of middle-level technicians and skilled workers. Microelectronics lends itself to applications which could improve the quality of life of the large masses of population in rural areas of developing countries, either through providing income-generating opportunities or through direct improvement of welfare. It should, however, be remembered that this is a potential still to be tapped and one which enterprises in developing countries may not attempt in the absence of a "market pull". On the other hand, the products developed for the markets of the developed world are already there. This underlines the need for controlling the applications of microelectronics in developing countries through a selective policy. Other advantages of simpler microelectronics-based information and control products are that they can be made cheaply from standard off-the-shelf components which can be customized by the user; these can be very reliable, less sensitive to changes in environments and hard use; easier to develop and expand modularly and better able to withstand the inadequacies of other systems, skills and materials. Their use requires relatively low skills and decentralized applications are possible. The fact that microelectronics replaces many intricate shop-floor skills may be an advantage to those developing countries which have not yet built up such skills, thus saving training time and effort. This would enable them to enter into the export markets wherever and whenever feasible at an earlier stage of the production process of the product to be exported.

8. There is a growing perception among developing countries that while the capacity to develop and utilize applications is an important step in the introduction of microelectronics for socio-economic development, attempts at developing applications should not be at the expense of efforts to develop design and manufacturing capabilities for components. The latter efforts are of central importance, since mastery of the technology is not otherwise possible. Such views were forcefully

expressed in the UNIDO/ECLA Expert Group Meeting on Implications of Microelectronics for the ECLA Region, held in June 1982. The meeting stressed that the criteria for applications should be derived from a diagnosis of the needs, and ultimately, for the development strategy of each country. Neither should the development of applications not also be viewed as an isolated technological problem. The application effort should encompass the chain of activities essential to successful production and use, ranging from the perception of a demand to translating it through technology as a cost-effective way of meeting demand. The interaction of a number of "agents" is involved, namely, government, industry and services, users and electronics professionals.

III. UNIDO's Activities in Microelectronics

9. It is against the background discussed above that UNIDO's activities to promote microelectronics technology for development should be viewed. Initiatives so far taken by UNIDO are summarized here under and grouped under headings that identify their objectives.

A. Conferences, Missions, Studies

10. Information technology, as covered by the term "informatics" and extending beyond data-bank systems and networks to industrial mangement tools and industrial processes, is at a stage of dynamic growth, particularly through the use of microprocessors. UNIDO co-sponsored a Conference on Informatics and Industrial Development with the Irish National Board for Science and Technology and Trinity College, Dublin, in March 1981 highlighted the importance developing countries attach to information developments, which are of substantial consequence to current industrial development strategies.

11. In June 1981 UNIDO organized a meeting of experts on the implications of technological advances in microelectronics for developing countries. The meeting emphasized the importance of actions at the national level relating to manufacture, industrial and other applications, software development and the formulation of a national

microelectronics strategy. Actions at the international level were also recommended, including a continuous monitoring of observed trends and their impact on various sectors, as well as the development of pilot projects and programmes dealing with applications and software.

12. Following the June 1981 meeting, a mission of experts visited four developing countries in different regions to promote selective applications of microelectronics and software development. Apart from reviewing the national situation in the countries visited, the mission recommended an approach to microelectronics application, including software, and suggested models of microprocessor application centres and software houses.

13. In the Tbilisi Forum earlier referred to, and in related expert meetings a suggestion was made that an international centre for microprocessor applications be established. In addition, a symposium on Microelectronics for Productivity held at New Delhi in April 1983 and co-sponsored by UNIDO, requested UNIDO to take the lead in promoting the establishment of an Asian Centre for Electronics. As a starting point for examining the various requests for regional and international action, a series of country case studies, aimed at the national level, were initiated to identify the scope for regional and international co-operation. It is expected these studies will provide concrete information and meaningful approaches for regional and international action. Country studies published so far cover Bangladesh, Brazil, India, the Republic of Korea, Pakistan and Venezuela. An overview of the microelectronics industry in these countries has also been prepared.

14. UNIDO was the first United Nations body to promote the concept of software engineering as an industry developing countries could establish. The concept was elaborated through three studies dealing with the importance of software for developing countries, the approach to software development in those countries, and guidelines for software production. Further work in this area would include the promotion and development of software for specific applications of relevance to developing countries including applications in various industrial sectors. A report on the commercialization of software covering main issues and contractual terms and conditions, was prepared and submitted

to the Ninth Meeting of Heads of Technology Transfer Registries. Through these efforts and by other means it is proposed to build up a bank of application software for the benefit of developing countries.

15. An Expert Group Meeting of the Economic Commission for Latin America (ECLA)*/ was held by UNIDO in June 1982 in Mexico, in co-operation with ECLA, at which the socio-economic implications for Latin American countries of advances in microelectronics were analysed and a Co-operative Latin American Programme of Action in the field of microelectronics was recommended. Follow-up action to draw up such a Co-operative Programme has been initiated by UNIDO and the Economic Commission for Latin America and the Caribbean (ECLAC). As a step in this direction a Latin American Microelectronics Network including the Caribbean (REMLAC) was proposed following a high-level expert team mission to Venezuela in 1983. At the request of the Government, the experts looked at the facilities of an existing national institution in Venezuela with a view to upgrading it with UNIDO's assistance to become a nodal point for the proposed network. Other nodal points in different parts of the region will be identified. A meeting will take place in June 1985 at Caracas to establish REMLAC and develop a programme of co-operation among the participating countries.

16. UNIDO has also co-operated with the Economic Commission for Western Asia (ECWA) in the preparation for and conduct of the Expert Group Meeting on the Development of Microelectronics in the ECWA region, held on 4-7 March 1984, in Kuwait. Recommendations made at that meeting requested UNIDO, inter alia, to look into the possibility of establishing a silicon foundry with design facilities in the ECWA region. A UNIDO consultant undertook a preliminary mission in December 1984 which will be followed up by an in-depth study of the market potential of future products in the countries of the region and to assess the scope and potential of local manufacture.

17. In regard to Africa, UNIDO with UNCSTD, OAU and ECA co-sponsored a meeting of African scientists on the implications of new technologies in the implementation of the Lagos Plan of Action and the programme for the

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*/ The Economic Commission for Latin America (ECLA) was extended to include the Caribbean on 27 July 1984.

Industrial Development Decade for Africa. The meeting was held at Mbabane, Swaziland, from 22 to 26 October 1984. A national meeting on applications of microelectronics and software was organized by UNIDO in Kenya and took place from 18 to 23 February 1985. Representatives from countries of the region such as Ethiopia, the Sudan, Tanzania and Zambia attended.

B. Technical Assistance Projects

18. A request for assistance has been received from GEPLACEA (Group of Latin American and Caribbean Sugar Exporting Countries) which covers approximately 700 sugar mills in 21 member countries, for help in the introduction of microcomputers for optimization of production without too much additional investment. A pilot project will be implemented at a place yet to be selected and, if successful, the procedures, software and computing configuration could be utilized for other cane sugar producers.

19. The UNIDO secretariat has been assisting the Mexican Government in setting up a permanent national team to monitor technological advances through a project financed by UNFSSTD. Under this project a national level workshop has already been held. Thereafter three experts specifically investigated the microelectronics industry from its numerous aspects and suggested, in the light of the technology trends in the world, actions that the Mexican Government could pursue.

20. Other activities include: support to a training workshop in Brazil; studies on biomedical applications and power devices prepared on the basis of that workshop; a pilot project for a rural development information system in the state of Karnataka, India; and a field study on the computerization of a small-scale industry sector in India. A study on the use of computers for the organization of meat production and processing based on the experience gained from the system in the Philippines is under preparation.

C. Co-operation Mechanisms

21. In an effort to co-ordinate the activities of organizations and professional groups active in the area of information technology for development, the UNIDO secretariat convened a meeting in Vienna from 21 to 23 March 1984 which brought together representatives of these groups, identified possible areas of co-operation and considered a mechanism of being kept mutually informed and formulating joint programmes. In addition to representatives of organizations, selected specialists from developing countries were also invited to present their countries' policies and requirements. As a result of this meeting a Consultative Group on Information Technology (COGIT) has been established which periodocally will meet to review ongoing activities, exchange experiences and formulate joint programmes. A directory of these groups and organizations will also be prepared by UNIDO which will be updated as new organizations join COGIT.

22. From UNIDO's experience it is clear that many scientists and technologists including those at the cutting edge of the relevant technologies are willing and eager to devote some of their time from their busy schedules towards solving development problems. It is important that the interest and efforts of such persons be systematically mobilized. In this connection a workshop organized by UNIDO at Dubrovnik suggested a Referral System of Scientists and Technologists in technological advances, including microelectronics. The Referral System was proposed for consideration and supported by UNIDO IV. Preliminary work for compiling this System has already been initiated by UNIDO.

D. Information Dissemination

23. The impact of microelectronics has, in UNIDO's programme of industrial studies, been viewed from the point of view of restructuring world industry. Two studies have been so far been completed: "The impact of microelectronics on the international economic setting: the

case of computer-aided design" and "Restructuring world industry in a period of crisis - the role of innovation: an analysis of recent developments in the semi-conductor industry".

24. A quarterly bulletin, the Microelectronics Monitor, has been published since January 1982 to create awareness and provide current information for a target audience of policy makers, scientists and technologists, particularly in developing countries. A survey of technological and market trends during 1982-1983 has been published by the Monitor. A special supplement reviewing developments in flexible manufacturing systems (FMS) will be published in February 1985.

25. A comprehensive list of documents published so far by the Technology Programme of UNIDO with regard to microelectronics is attached as Annex I.

Annex I

List of documents published by the UNIDO Technology Programme on the Implications for developing countries of advances in microelectronics

Expert Group Meeting on Implications of Technological Advances in Microelectronics for Developing Countries, Vienna, 10-12 June 1981

IS.246 and Corr. 1	Implications of Micro-Electronics for Developing Countries: A Preliminary Overview of Issues.
UNIDO/IS.242/ Rev.1 and Corr.1	Report on Exchange of Views with Experts on the Implications of Technological Advances in Micro-Electronics for Developing Countries, Vienna, Austria, 10-12 June 1981.

UNIDO/ECLA Expert Group Meeting on Implications of Microelectronics for Develop[illegible] Countries, Mexico, 7-11 June 1982

ID/WG.372/1	Prospects of Microelectronics Application in Process and Product Development in Developing Countries by Michael Radnor
ID/WG.372/2	Microelectronics and Government Policies: The Case of a Developed Country by Ernest Braun, Kurt Hoffman and Ian Miles.
ID/WG.372/3	Microprocessors and Productivity: Cashing in our Chips by Robert T. Lund.
ID/WG.372/4	Microelectronics and Telecommunications in Latin America by Edgardo Galli.
ID/WG.372/5 and Corr.1	Microelectronics: Its Impact and Policy Implications by Juan F. Rada.
ID/WG.372/6	Potential Applications Suitable for Microprocessor Implementations: Some Illustrative Possibilities by James Oliphant
ID/WG.372/10	Elements for the Formulation of a Regional Programme of Action in the Area of Microelectronics by Carlos Aguirre and Roberto Heredia
ID/WG.372/11	Telecommunications and Microelectronics: Some Observations by E. Galli, M. Welch and R. Herrera.
ID/WG.372/12	The Development of Microelectronics in Argentina by O. Filipello and R. Sagarzazu.
ID/WG.372/13	Cultural Aspects of Microelectronics Technology by Carlos I.Z. Mammana.
ID/WG.372/14	Microprocessor Applications and Industrial Development by Robert T. Lund.

ID/WG.372/15	Microelectronics and the Development of Latin America: Problems and Possibilities for Action by ECLA/UNIDO Joint Industry and Technology Division and Eugenio Lahera and Hugo Nochteff.
ID/WG.372/16	Microelectronics in Peru. Country Monograph by R. Herrera.
ID/WG.372/17	Report, UNIDO/ECLA Expert Group Meeting on Implications of Microelectronics for the ECLA Region, Mexico City, Mexico 7-11 June 1982

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UNIDO/IS.230	Technological Perspectives in Machine Tool Industry with special Reference to Micro-Electronics Applications by S.M. Patil.
ID/WG.384/5/ Rev.1	Microelectronics and Developing Countries: Towards an Action-oriented Approach.
ID/WG.401/6	Some Considerations About a Practical Approach to the Development of Technical Infrastructure for Microelectronics by G. Fernandes de La Garza.
UNIDO/IS.331	Prospects of Microelectronics. Application in Process and Product Development in Africa by Michael Radnor.
UNIDO/IS.338	Proceedings of the First Meeting on Co-operation between Scientific and Industrial Sectors in Microelectronics held at Mexico City, 14 and 15 June 1982.
UNIDO/IS.351	Microprocessor Applications for Developing Countries by James Oliphant.
UNIDO/IS.383	Problems of Software Development in Developing Countries.
UNIDO/IS.392	The Impact of Microelectronics on Biomedical Applications in Developing Countries by Cor. L. Claeys.
UNIDO/IS.415	Informatics for Industrial Development by Richard J. Nolan.
UNIDO/IS.438	Technology and Market Trends in the Production and Application of Information Technology by John Bessant
UNIDO/IS.439	Guidelines for Software Development in Developing Countries by R. Narasimhan
UNIDO/IS.440	Guidelines for Software Production in Developing Countries by H. Kopetz
UNIDO/IS.444	A Silicon Foundry to Service Developing Countries' Needs: A Preliminary Approach by the UNIDO secretariat

UNIDO/IS.446	Software Engineering: A Survey by W. Turski
ID/WG.419/1	Microelectronics Applications for Developing Countries: Preliminary Issues for Concerted Action
ID/WG.419/13	Report of Discussion Meeting on Information Technology for Development
UNIDO/IS.489	State-of-the-Art Series on Microelectronics No. 1 Venezuela No. 2 India No. 3 Republic of Korea No. 4 Pakistan No. 5 Bangladesh
UNIDO/IS.500	Overview of the Microelectronics Industry in Selected Developing Countries by S.E. Lalor