OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

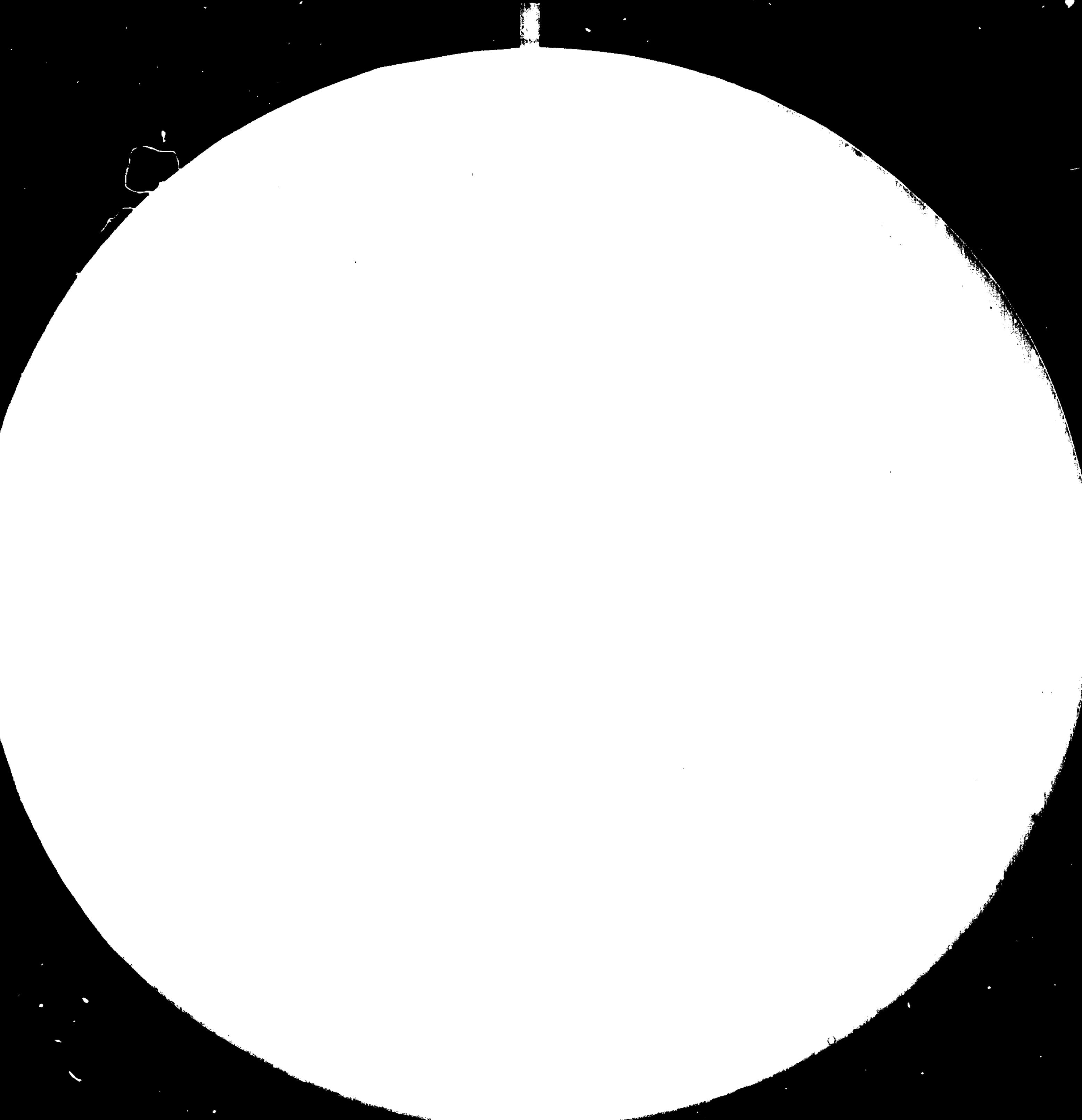
Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

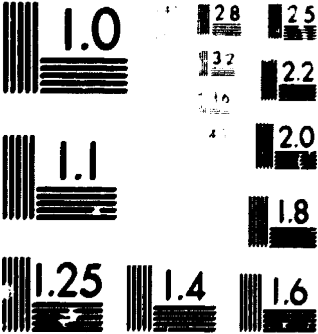
CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org





MICROCOPY RESOLUTION TEST CHART

11654-E

Distr.
LIMITED

ID/WG.372/13
9 August 1982

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

UNIDO/ECLA Expert Group Meeting on Implications
of Microelectronics for the ECLA Region

Mexico City, Mexico, 7 - 11 June 1982

CULTURAL ASPECTS OF MICROELECTRONICS TECHNOLOGY*

Country Paper: Brazil

by

Carlos I.Z. Mammana**

003155

* The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Professor, Faculdade de Engenharia de Campinas, Universidade Estadual de Campinas, Cidade Universitaria, 13100 - Campinas - Sao Paulo.

V.82-29419

Contents

I. The Cultural Content of Microelectronics Technology

The importance of microelectronics has been broadly rocognized for the future development of the industry as well as for the strength of its impact on the cultural development of people throughout the world. This understanding generated a preoccupation with evaluating the progress achieved in this area and also with the strategies of linking the results of this technology to adequate applications for the development of humankind.

Perticularly important, in this context, is the influence of the fast evolution of the technology of information on the developing countries, because, in the absence of direct participation in the cultural growth promoted by the development in this area these countries suffer many difficulties of cultural adaptation for the use of microelectronic chips as well as in their fabrication. It is, thus, of great importance to understand the determining factors of the microelectronics industrial development and the elaboration of a strategy that brings these countries to participate, within their natural limitations, in this development.

This is not a simple task, however. The technology on information evolved long ago as a response to the demand for more and more efficient instruments for communications, storing and handling of information and for social organization. Thus, the artifacts needed for this improvement became more complex as the time elapsed, following the complexity of social relations and the development of industry.

The fast development that occurred during the Industrial Revolution in the eighteenth century had a great influence on the technology of information because it enabled the enrichment of the structure of the industrial basis needed for its development. The modern technology of information, of which microelectronics is one of the great outcomes, is a direct consequence of this industrial basis and the countries that did not participate actively in the Industrial Revolution tend to have difficulties in participating in this new phase of development. These difficulties arise from the fact that the cultural content needed for the establishment of this industry is very large, including technological developments made in a great variety of technologies as, for instance, metallurgy, fine and precision mechanics, high resolution optics, physico-chemical processing, complex systems design and sophisticated production controls techniques.

The developing countries that wish to use profitably this technology and, at the same time, be capable of industrial production of microcircuits may choose two main strategies: they may limit themselves to the utilization of integrated circuits that are produced by other cultures and act as users of this technology or they may work towards the enhancement of their cultural basis and try to participate in the process as generators of know-how and technological actions in the area.

The option towards one of these strategies is connected with the existing cultural ability and with the elaboration of feasible programmes that aim in the short and long-term at a more intense participation in the evolutionary process of this technology. The ideal situation for the countries in this situation is that of leaving the position of technology consumers to that of producers. To achieve this process, the developing countries must face the need for the absorption or creation of cultural components at present lacking and in many cases components that are not well matched with the cultural structure of the society. Thus, this absorption is not straightforward and is dependent on many factors that include not only those of the psycho-social structure.

II. Sources, Forms and Factors of Technology Absorption

When we refer to the absorption of technology we are considering the difference in the situation of the cultural levels of the two human groups considered. This means that there is a human group with a given cultural content that is richer than that of the other. In this case, contact produces information transfer between the two groups; the way of life of the richer group induces aspirations and necessities.

This situation results either in a dependence of the group that has a poorer culture or is evolving and reaching towards new social needs.

The enhancement of a culture is always made by increasing pertinent information and through productive ability. This implies a learning structure and attitude that must be disseminated over a broad area including the uses, beliefs, artifacts fabrication, materials extraction and purification etc. For this reason, this is not a simple matter of aggregation of a "supplement" of information because much of the new information is not compatible with the existing structure and, thus, must be modified to be absorbed and used successfully without destroying the existing cultural structure.

It is of great importance to understand the way this learning is achieved and to determine the sources of information, and also the forms and factors of absorption. It is not intended in this document to deal with a complete analysis of this cultural interaction but the analysis will be limited to the part of the culture that corresponds to the technology know-how.

The sources of technology may be internal and external to the human group.

The internal sources may be of three distinct types. First, the existing industry in the less developed culture is a source of technology and may generate conditions of evolution as a result of its contact with the market, identifying the needed products and, in the first phase, trying to satisfy the demand with the use of artifacts made by the more developed culture. With the growth of its participation in the supply of products or services and with the increase of its competitivity, the industry tends to participate in the production of artifacts that increase this competitivity. In the case of the equipment industries and the services companies connected with the information area the natural way is to try to reach self-sufficiency in the production of integrated circuits and other components.

Another internal source of technology for the developing culture is the research and development (R+D) institutions, whose social function is that of promoting a cultural evolution which envisages overcoming the existing cultural level. This source is intended to show results in the longer term in comparison to that of industry and to enable the cultural infrastructure to support industrial development.

The third source is the institution of research and teaching, whose socio-cultural function is that of transferring, with the highest efficiency and speed, the cultural information accumulated by the social group. Its function is also, that of forming the human resources that will become the fixing agent of the culture and the driving force of its development, that will enable the human group to overcome its present stage.

As for the external sources, a model must be considered in which there is mutual interest in the transfer of technological information among the two human groups. In this regard, it is possible to identify two sources. The first one is connected with the industrial area and refers to the purchase of industrial packages that enable the immediate production of goods to occupy specific areas of the market or for the satisfaction of urgent needs of basic services of great social importance. This is a source that enables the fast but short-lived overcoming of the cultural deficiencies because it creates means to satisfy the needs resulting from the development but influences the cultural structure of the human group very superficially and is not fixed in the medium and long terms.

The other external source that creates longer term effects and has greater penetration is accomplished by broad continuing contacts on a local technological basis and with the external group, particularly for the training of human resources. This interaction may help the development of the local efforts and must be made in an organized way, following a well defined strategy. The use of this source without control and organization may destroy the structure of the less-developed culture instead of enhancing it.

One of the possible forms of technology absorption is to buy technology from the richer cultures and this can be done either by acquiring a closed technology package or an open package. In the first case, the absorption of technology is limited and cannot evolve to a new status. In the second case, it is possible to improve the acquired status of technology evolving to a more sophisticated one with the participation of a larger group of local individuals.

The number of individuals that participate in the absorption of technology and also the penetration of this absorption in the culture is obtained through the training of personnel, both by industrial training and by the universities. This tends to deepen the technological insight of the individuals but there is the risk that they will be trained in topics that will not integrate a full cultural enrichment that would lead to the desired results of technological absorption.

These forms of absorption can be combined in an integrated effort of technological ability in which the various elements of the society involved in technology act as a system and, thus, a harmonious evolution may result.

In order to achieve these results, some important factors must be considered. First, there must be a market for the products that are envisaged, and this factor acts as a selector for the kind of structure the technological development requires. Once this is established, there must be a supplier and a receiver for the technology and this implies that the social-cultural environment of the receiver cannot be such that there exists none or very little ability in the area. This means that the absorption will be limited to the areas of available skill. In the case of microelectronics, this may signify that, for instance, of all the chip fabrication process, only chip assembly can be learned.

Supposing that there is a minimum local capacity, one of its fundamental characteristics is to enable the creation of new ideas and, most important, to create the ability of realizing these ideas.

This means that the effort of building up technological abilities must be broad, involving its infrastructural aspects. In the case of microelectronics, these aspects involve knowledge that goes from materials to systems. As the new inventions, needed for the evolution from one status to another must be tested, the local ability must include materials processing, fabrication equipment, design and construction, etc.

Thus, the decision of developing a complex technological field in the case of a given culture implies a systemic effort that involves an industrial policy, a scientific policy, human resources development and, of course, financial resources to sustain them.

III. The Approach to Microelectronics in Brazil

In Brazil, the demand for electronics is defined by several important fields that include telecommunications, computers, process control and customer electronics. This demand is reflected in a market of about 200 million dollars in 1982 and justified the efforts made to introduce microelectronics technology. This effort began in 1967 when a report had been issued on the needs for improvement of the technology of automation. Thi[illegible] report recommended the formation of various groups at the univer[illegible], working in subjects extending from materials processing to s[illegible]design. At this time the first laboratory was created to dea[illegible] microelectronics at the University of São Paulo and came into operation in 1970. Since 1972, the Brazilian Telecommunications Company, TELEBRÁS, contracted the Universities to work on several basic development programmes. This was done to achieve a technological basis for the improvement of their equipment. The most important in the area have been the optical communications, microelectronics and electronic grade materials laboratories at the University of Campinas.

At this time the industrial area was composed of about a dozen transnational companies of which only two are manufacturing devices for consumer applications. The other limited their activities to encapsulation and test.

In October 1979, the Federal Government created a Special Secretariat of Informatics - Secretaria Especial de Informática (SEI) of the National Security Council with the purpose of establishing a strategy for the development of the technology of information.

Microelectronics has been considered a key point in this policy and by March 1981, a decree was issued by the President of the Republic in which it was stated that a plan should be elaborated for the development of the area. This resulted in a workshop that made a study on this subject, congregating a large number of experts. Extending concepts already mature from the previous experience, this group recommended a systematic approach for the development of microelectronics technology involving universities, manufacturing industries and the creation of a research and development institution. The purpose of this institute would be to lead the technological development in the area, and to work in close collaboration with the universities and industries. An evaluation made by SEI of the possible companies that could be involved in the industrial area indicated Itau S/A and Companhia Docas de Santos. These companies prepared in six months a detailed plan of their activities. At the same time, a plan was prepared for the R+D institution with the collaboration of Brazilian and international consultants through a contract with the University of Campinas and supported by SEI and UNIDO. The three plans are now being analysed by the Special Secretariat of Informatics.

The R+D institution intends to start operation in 1982 and a budget has been proposed of approximately US$ 40 million in the first three years of operation. This institute will be able to co-operate with the industries supplying support during their introduction. On the other side it will give support to a research programme involving the universities and R+D institutions with the goal of training personnel and developing new technologies in the long-term.